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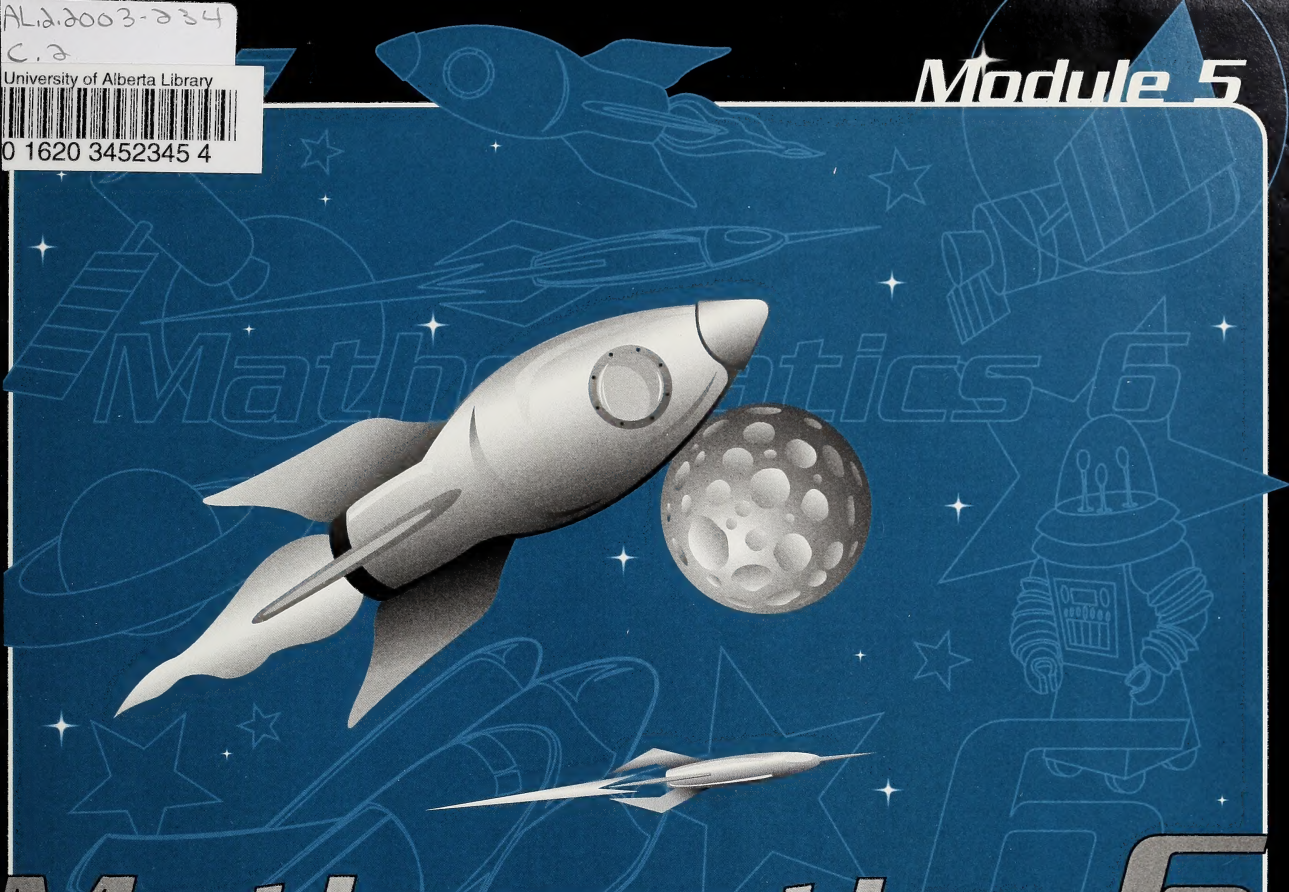
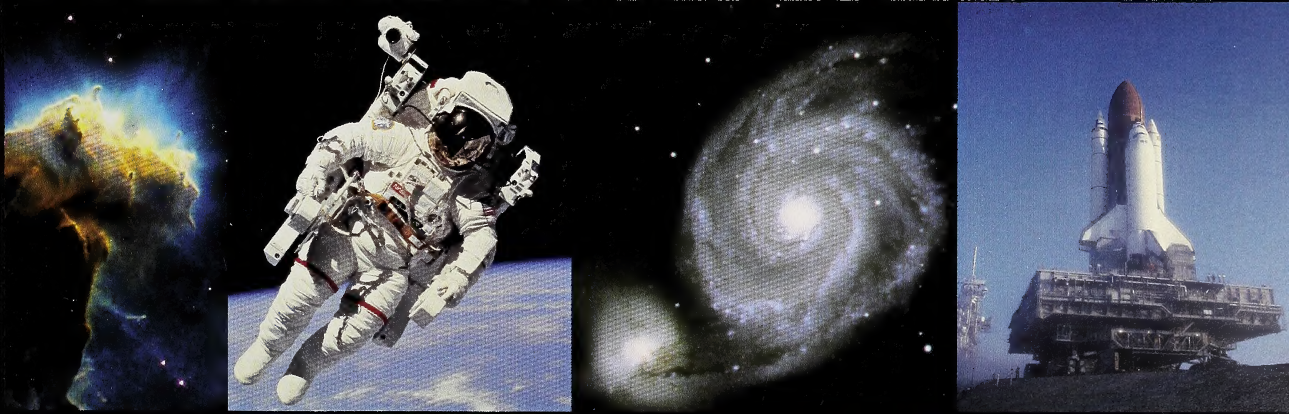
Module 5



Mathematics 6



Measurement

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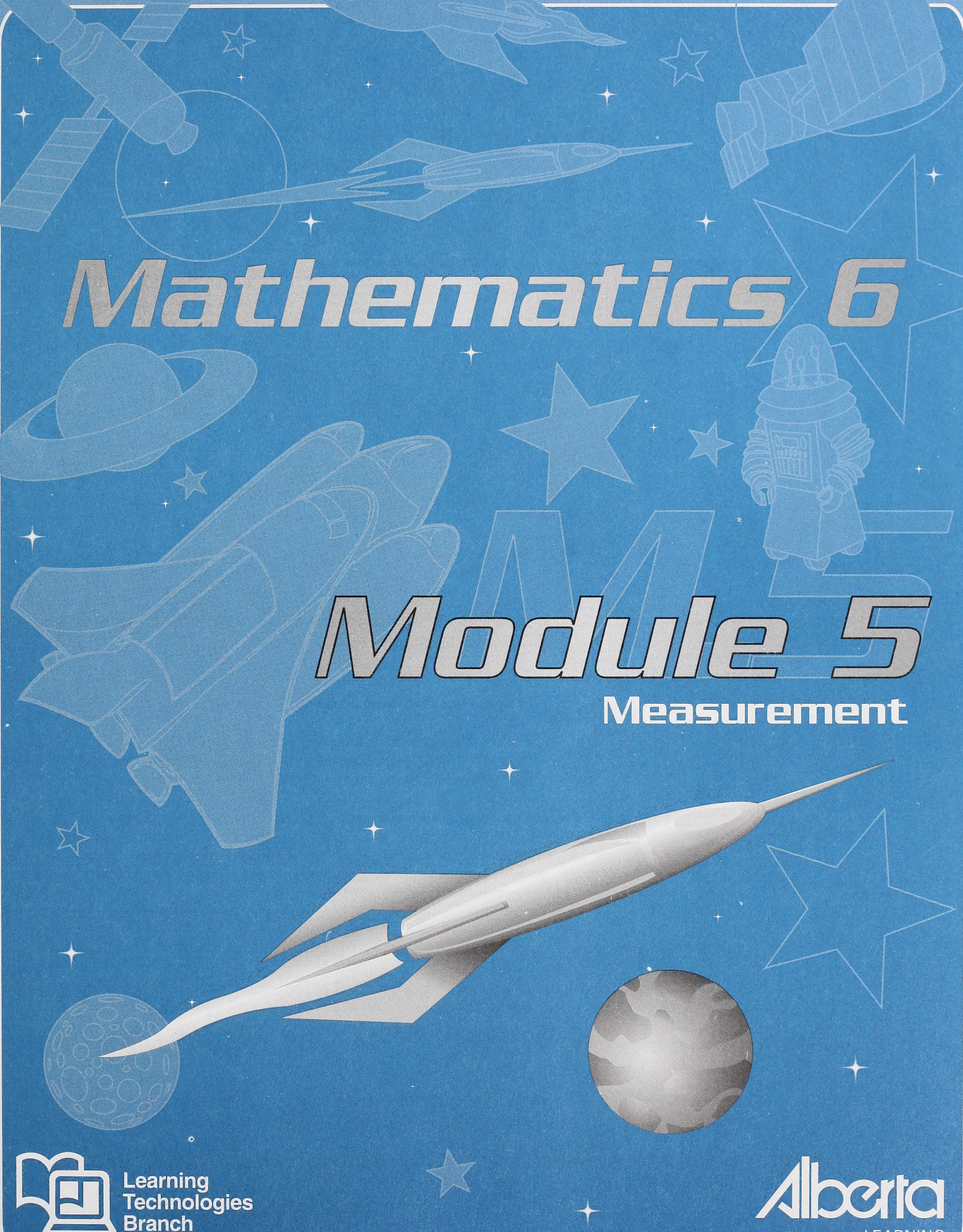

Mathematics 6

Module 5

Measurement

Learning
Technologies
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Mathematics 6
Module 5: Measurement
Student Module Booklet
Learning Technologies Branch
ISBN 0-7741-2384-2

The Learning Technologies Branch acknowledges with appreciation the Alberta Distance Learning Centre and Pembina Hills Regional Division No. 7 for their review of this Student Module Booklet.

This document is intended for	
Students	✓
Teachers	✓
Administrators	
Home Instructors	
General Public	
Other	

You may find the following Internet sites useful:

- Alberta Learning, **http://www.learning.gov.ab.ca**
- Learning Technologies Branch, **http://www.learning.gov.ab.ca/ltb**
- Learning Resources Centre, **http://www.lrc.learning.gov.ab.ca**

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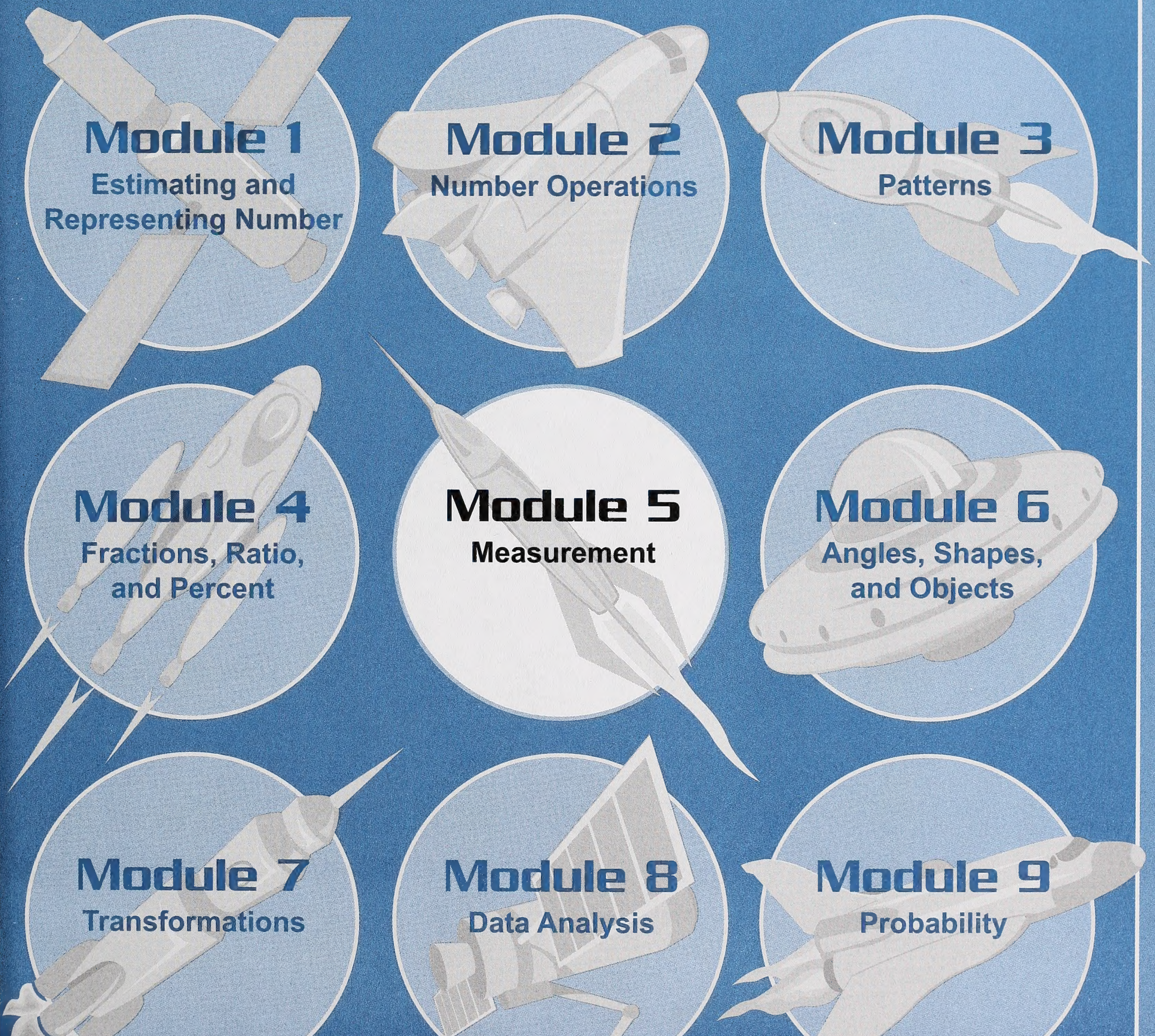
Welcome to Mathematics 6

Mathematics 6 contains nine modules.
You should work through the modules in order (from 1 to 9) because concepts and skills introduced in one module will be reinforced, extended, and applied in later modules.



Module 1
Estimating and Representing Number

Module 2
Number Operations

Module 3
Patterns

Module 4
Fractions, Ratio, and Percent

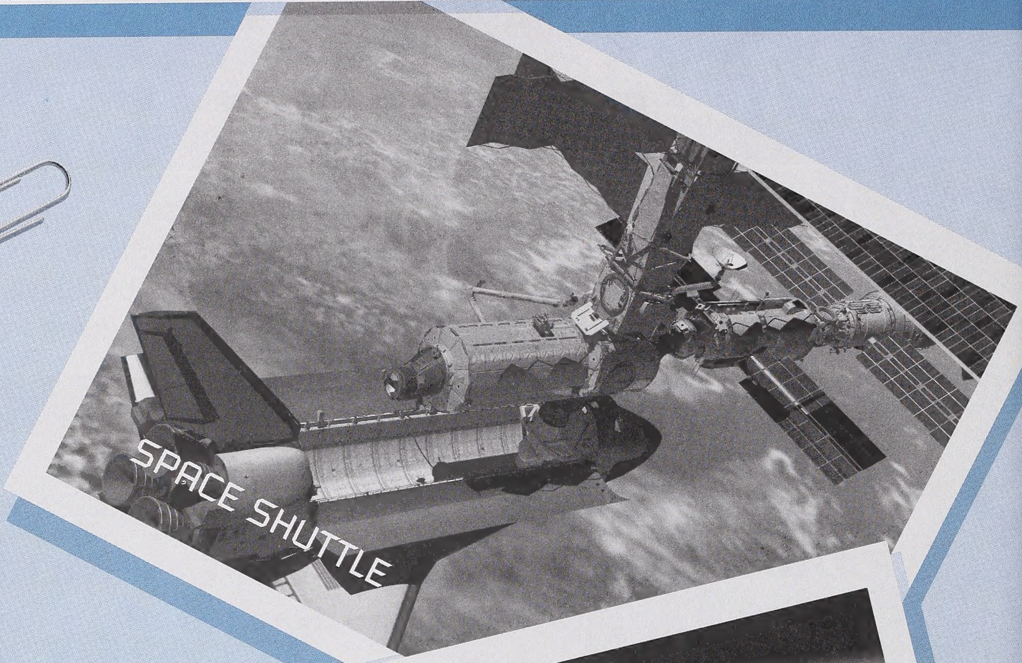
Module 5
Measurement

Module 6
Angles, Shapes, and Objects

Module 7
Transformations

Module 8
Data Analysis

Module 9
Probability


SPACE SHUTTLE

INTERNATIONAL SPACE STATION

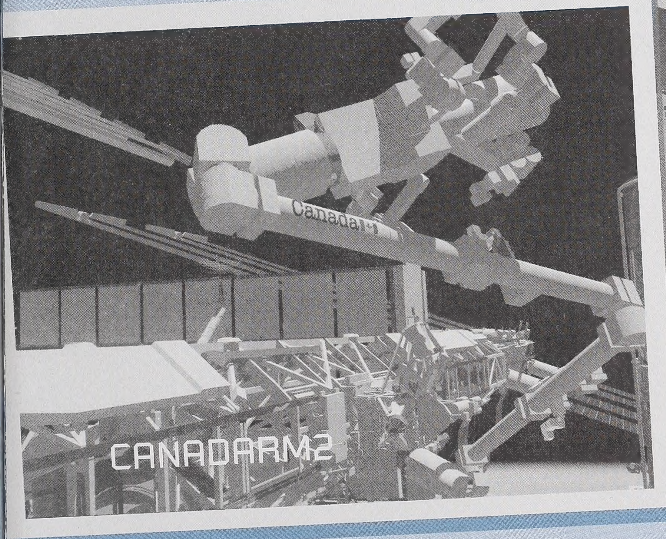
Adventures in Outer Space

Matthew: Wow, what a wonderful experience it was meeting Colonel Chris Hadfield at the Odyssium! He gave a presentation here in Edmonton on July 9, 2001, and talked about his adventures in space, including his mission aboard the Space Shuttle *Endeavor* to attach Canadarm2 to the International Space Station.

It's too bad you missed it, Kylee. You were away visiting your grandmother in Slave Lake.

Kylee: My trip was great, but I sure wish I could have heard Colonel Hadfield talk about being the first Canadian to walk in space. But I've got great news for you, Matthew! Commander Claire from the International Space Station is coming to town, and you and I will be spending some time with her.

I can't wait to hear about her adventures in space!



ATIONAL SPACE STATION

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Commander Claire

Course Features

Take the time to look through the Student Module Booklets and the Assignment Booklets and notice the following design features:

- Each module has a Module Overview, Module Summary, and Review.
- Each module has several lessons. Each lesson focuses on a big idea that is central to the topic being learned in the module.
- Each lesson has several activities. An activity in each lesson is related to the Adventures in Outer Space theme.
- Each module has a Glossary and an Answer Key in the Appendix. In several modules there are also special pull-out pages in the Appendix.
- Each module has special exercises that focus on certain mathematical skills. The Numbers in the News project involves a scavenger hunt for samples of math in everyday life. The Keystrokes exercise introduces some "funky features" of the calculator that can be used to explore and practise important number ideas. Just the Facts gives you the opportunity to practise your basic number facts by doing a timed drill with your home instructor. The Mental Math exercise introduces an estimation skill or mental-computation strategy that you can use to sharpen your mental math skills.
- Each module references the Mathematics 6 Companion CD that includes additional material for review and mastery.

Required Resources

There are no spaces provided in the Student Module Booklets for your answers. This means you will need a binder and loose-leaf paper or a notebook to do your work.

In order to complete the course, you will need a copy of the Mathematics 6 textbook, *Quest 2000: Exploring Mathematics*, *Grade 6*, the soft-cover book *Quest 2000: Exploring Mathematics: Practice and Homework Book*, *Grade 6*, a basic four-operation calculator (such as the TI-108 calculator), and various manipulatives (base ten blocks and pattern blocks).

If you wish to complete the optional computer activities, you must have access to a computer that is connected to the Internet.

You will also need access to a computer to view material on the Mathematics 6 Companion CD.

Visual Cues

For your convenience, the most important mathematical rules and definitions are highlighted. Icons are also used as visual cues. Each icon tells you to do something.

	Use your calculator.	www	Use the Internet.
	Refer to the textbook or the Practice and Homework Book.	cd	Use the Mathematics 6 Companion CD.

Assessment and Feedback

The Mathematics 6 course is carefully designed to give you many opportunities to discover how well you are doing. In every activity you will be asked to turn to the Appendix to check your answers. Completing the activities and comparing your answers to the suggested answers in the Appendix will help you better understand math concepts, develop math skills, and improve your ability to communicate mathematically and solve problems.

If you are having difficulty with an activity, refer to the Answer Key in the Appendix for hints or help. As well as giving suggested answers to the questions, the Answer Key gives you more information about the questions.

Twice in each module you will be asked to give your teacher your completed assignments to mark. Your teacher will give you feedback on how you are doing.

After your teacher marks an assignment, be sure to review your teacher's comments and correct any errors you made.

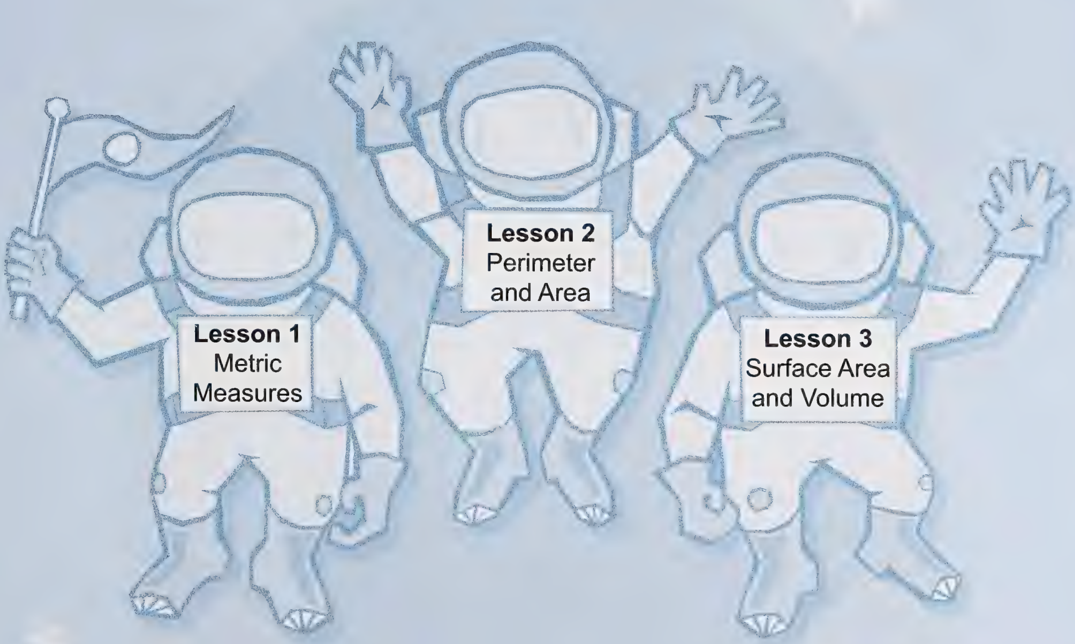
There will be a final test at the end of the course. You can prepare for the final test by completing the Review at the end of each module.

Module Overview

Do you ever dream about participating in a space mission to Mars or Titan (one of Jupiter's moons), or perhaps even beyond our solar system? You would need to be fitted with your own spacesuit! Designers would measure your height, weight, and bulk to ensure your suit would fit, be flexible and comfortable, and allow you to perform your duties. These measurements would be taken using metric units.

In this module you will extend your understanding of the metric system. You will use correct terminology and appropriate symbols when dealing with the perimeter, area, and volume of rectangles, polygons, and prisms. Of course, you will apply your skills in a variety of problem situations.

Are you prepared for your mission?


Lesson 1
Metric
Measures
Lesson 2
Perimeter
and Area
Lesson 3
Surface Area
and Volume

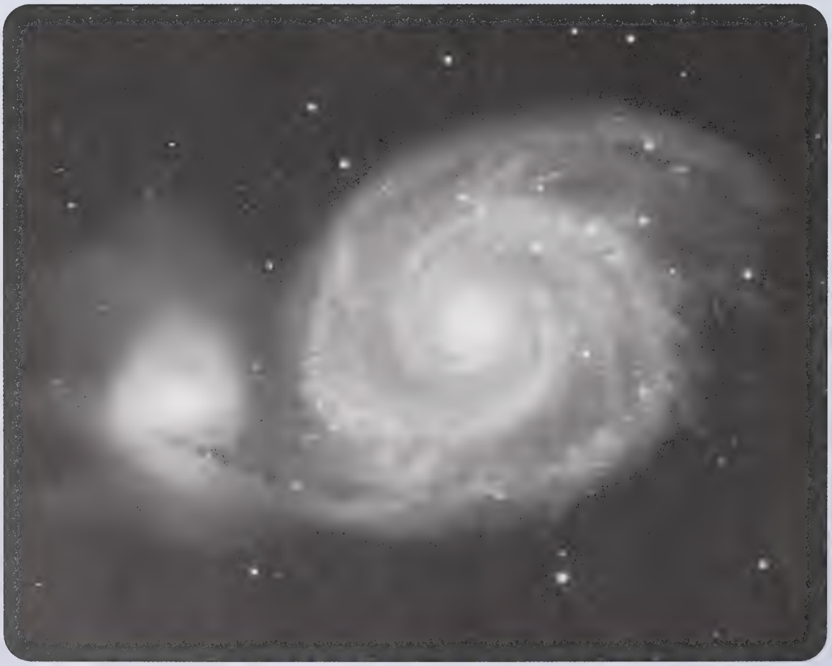
Your mark on this module will be determined by how well you complete the two Assignment Booklets.

The mark distribution is as follows:

Assignment Booklet 5A	
Lesson 1 Assignment	30 marks
Lesson 2 Assignment	30 marks
Assignment Booklet 5B	
Lesson 3 Assignment	30 marks
Numbers in the News	10 marks
Total	100 marks

When doing the assignments, work slowly and carefully. Be sure you attempt each part of the assignments. If you are having difficulty, you may use your course materials to help you, but you must do the assignments by yourself.

You will submit Assignment Booklet 5A to your teacher before you begin Lesson 3. You will submit Assignment Booklet 5B to your teacher at the end of this module.



Numbers in the News

Read through the following list before you begin Module 5. Begin by collecting samples of the ideas you already understand; others you may collect as you learn about them in the module. The samples you collect will depend on the newspapers or magazines you use.

Scavenger Hunt

Cut out articles or advertisements from newspapers or magazines that show measurements using metric units being used in different situations. Here are some suggestions of things to look for:

- length (mm, cm, dm, m, dam, hm, and km)
- mass (g, kg, and t)
- capacity (mL, hL, L, kL)
- volume $\left(\text{mm}^3, \text{cm}^3, \text{dm}^3, \text{m}^3\right)$
- area $\left(\text{mm}^2, \text{cm}^2, \text{m}^2, \text{km}^3, \text{ha}\right)$
- articles about measurement

You will find further instructions for completing and submitting your project in Assignment Booklet 5B.

Lesson 1

Metric Measures

FREEDOM
EQUALITY
BROTHERHOOD

"Freedom, Equality, Brotherhood!" was the slogan of the French Revolution that changed France from a monarchy to a republic. The French Revolution also ushered in a new, efficient system of measurement that replaced an archaic and cumbersome one. The metric system was proposed to the French National Assembly in 1799, and today it is used almost everywhere in the world! It was legalized in the United States in 1866 and in Canada in 1871. It has been the primary system in use in Canada for over thirty years.

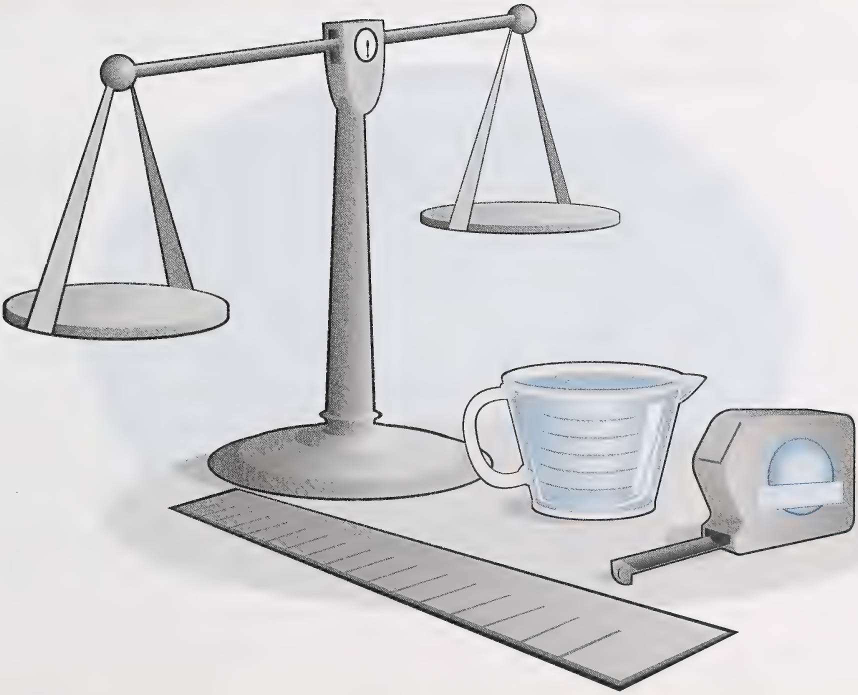
In this lesson you will discover that the International System of Metric Measures (SI) uses the same prefixes to name multiples and fractions of all metric units. This pattern makes it easy to express any measure using smaller or larger units by multiplying or dividing the measure by a power of 10, such as 10, 100, 1000, and so on.

The most commonly used prefixes and symbols are shown in the following table.

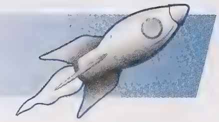
Prefix	Symbol	Meaning
kilo-	k	1000 of the unit
hecto-	h	100 of the unit
deca-	da	10 of the unit
--	–	1 of the unit
deci-	d	0.1 or $\frac{1}{10}$ of the unit
centi-	c	0.01 or $\frac{1}{100}$ of the unit
milli-	m	0.001 or $\frac{1}{1000}$ of the unit

If you have access to the Internet, you can find out more about the origins of the metric system at the following website:

http://www.essex1.com/people/speer/metric.html



Activity 1



Today you will investigate how length is measured in the metric system.

Measurements for space travel must be very accurate. What may seem to be just a tiny error can result in a huge error because of the immense distances in space.

Oh no,
we missed our target!

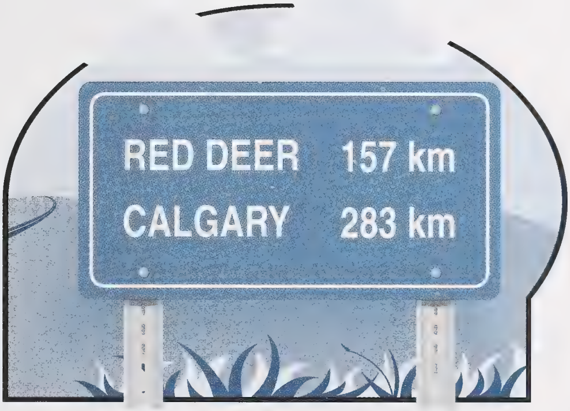
The basic unit of length is the **metre**. The following table shows how the SI prefixes are used when measuring length. The most commonly used units of length are shown in bold.

Unit	Symbol	Number of Metres Per Unit
kilometre	**km**	1000 m
hectometre	hm	100 m
decametre	dam	10 m
metre	**m**	1 m
decimetre	dm	0.1 m
centimetre	**cm**	0.01 m
millimetre	**mm**	0.001 m

1. Suppose that your metre-stick is 1 mm shorter than an exact metre, and you use it to measure the following items. Tell how much too short (in millimetres, centimetres, decimetres, and metres) each of your measurements would be. Would the error matter? Explain your answer.

   a. 1 m of ribbon to wrap a gift
   b. 10 m of cotton material to make some cushions
   c. 100 m of string for a kite spool

2. Suppose the instrument used to measure highway distances had the same error as the metre-stick in question 1. Tell how much too short (in millimetres, centimetres, decimetres, metres, and kilometres) each of the measured distances would be.



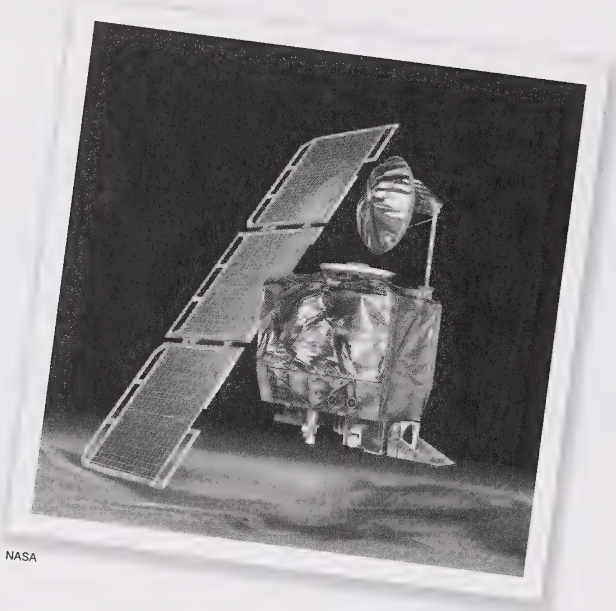
   a. 1 km
   b. 10 km
   c. 100 km

Question 3 is optional. Do this question if you need practice converting between units.

3. The moon is 384 321 km from Earth. Suppose the calculation for travelling to the moon had the same error as the metre-stick in question 1. Tell how much too short (in kilometres, metres, decimetres, centimetres, and millimetres) the calculated distance would be. Would the error matter? Explain your answer.

Check your answers on pages 82 and 83 in the Appendix.

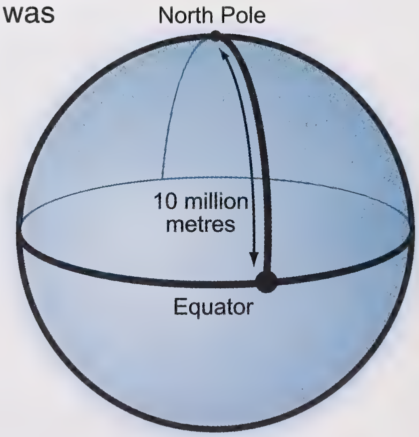
In questions 1 to 3, you saw how a tiny error in a measurement may hardly be noticed for a small length or distance, but it can cause a disaster when applied to huge distances in space. In fact, in 1999, a measurement error caused the $125 million United States Mars Climate Orbiter to crash and burn on the surface of Mars. This event is an example of why scientists must be very careful when calculating measurements.



NASA

4. The metre has an interesting history. It was first defined by the French Academy of Sciences in 1791 as one-ten millionth of the Earth's circumference measured from the North Pole to the equator.

   Using this definition of a metre, write the distance from the North Pole to the equator in metres and kilometres.



Earth

5. As you may imagine, accurately determining the distance in question 4 with eighteenth-century survey equipment was a difficult task. About 100 years later, in 1889, the metre was redefined as the distance between two marks on a metal bar made of platinum and iridium. This measure was accurate to one part in a million. This metal bar is kept under controlled conditions in a laboratory just outside Paris, France.

BUREAU INTERNATIONAL
DES POIDS ET MESURES

NIST HISTORICAL COLLECTION

a. How much of a millimetre is one-millionth of a metre?

b. If this metre was short by one-millionth of a metre, and it was used in calculations for travelling to the moon, tell how much too short (in metres and kilometres) the calculated distance would be. Would the error matter? (**Hint:** See question 3 for the distance between Earth and the moon.)

Questions 6 and 7 are optional. Do these questions if you like a challenge!

6. In 1960, the metre was again redefined as being equal to 1 650 763.73 wavelengths of orange-red light. This measure was accurate to four parts in a billion.

a. How much of a millimetre is four-billionths of a metre? Express your answer as a basic fraction.

b. If the measurement that was short by four-billionths of a metre was used in calculations for travelling to the moon, tell how much too short (in metres) the calculated distance would be. Would the error matter?

7. In 1983, the metre was once again redefined as the distance light travels in a vacuum in $\frac{1}{299\ 792\ 458}$ of a second. This measure is accurate to one part in ten billion. How many times more accurate is this unit of measure than the unit of measure for the metre in question 6?

Check your answers on pages 83 and 84 in the Appendix.

Sharing Time

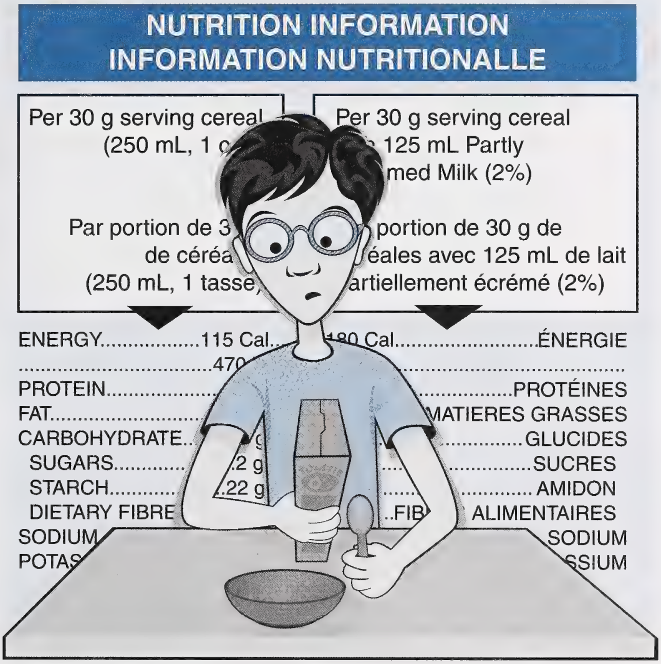
Now it's time to share what you have been learning with your home instructor.

Turn to page 21 of your Practice and Homework Book and do questions 1 to 5.

Discuss your answers with your home instructor.

Activity 2

Today you will investigate how mass is measured in the metric system.


NUTRITION INFORMATION
INFORMATION NUTRITIONALLE
Per 30 g serving cereal (250 mL, 1 c
Par portion de 3 de céréa (250 mL, 1 tasse
Per 30 g serving cereal 125 mL Partly med Milk (2%)
portion de 30 g de éales avec 125 mL de lait artiellement écrémé (2%)
ENERGY.................115 Cal...
.................................470
PROTEIN
FAT
CARBOHYDRATE
SUGARS............2 g
STARCH............22 g
DIETARY FIBRE
SODIUM
POTAS
180 Cal.........................ÉNERGIE
PROTÉINES
MATIERES GRASSES
GLUCIDES
SUCRES
AMIDON
..FIB ALIMENTAIRES
SODIUM
SSIUM

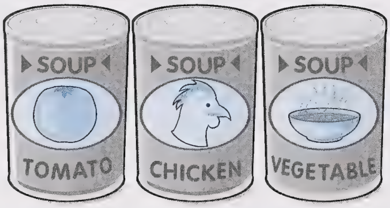
Have you looked at a cereal box and read the nutritional information on the side? This information lists the amount of protein, fat, carbohydrates, and other elements per 30-g serving.

Did you know the basic metric unit for mass is the **gram**? The gram was originally defined as the mass of 1 mL of water at 4°C.

The following table shows how the SI prefixes are used when measuring mass. The most commonly used units of mass are shown in bold.

Unit	Symbol	Number of Grams Per Unit
tonne	**t**	1 000 000 g = 1000 kg
kilogram	**kg**	1000 g
hectogram	hg	100 g
decagram	dag	10 g
gram	**g**	1 g
decigram	dg	0.1 g
centigram	cg	0.01 g
milligram	**mg**	0.001 g

The following table gives nutritional information for three kinds of soup. Use this information to answer questions 1 and 2.

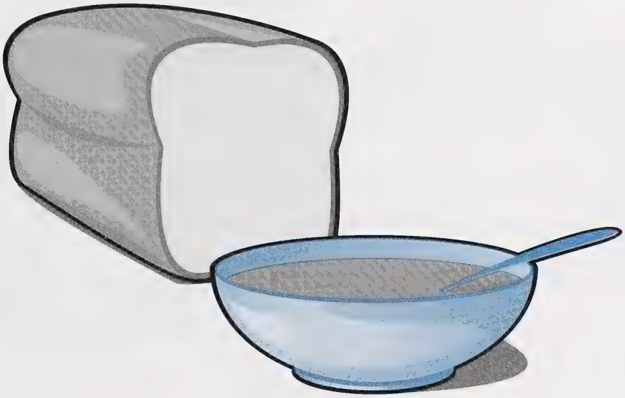


	Vegetable Soup	Tomato Soup	Chicken Noodle Soup
Nutrient	**Number of Grams of Nutrient Per 250-mL Serving**		
Protein	2.5	1.8	3.7
Fat	1.3	1.5	1.9
Carbohydrates	17	18	7.8
Dietary Fibre	3.4	1.6	0.4
Sodium	0.800	0.866	0.902
Potassium	0.211	0.227	0.051

1. Copy and complete the following table in your notebook to show the number of milligrams of potassium and dietary fibre per 250-mL serving of each of the three soups.

	Vegetable Soup	**Tomato Soup**	**Chicken Noodle Soup**
Nutrient	**Number of Milligrams of Nutrient Per 250-mL Serving**		
Potassium			
Dietary Fibre			

2. Steve ate one 250-mL serving of soup every day in April. On the first day, he ate vegetable soup; on the second day, he ate tomato soup; and on the third day, he ate chicken noodle soup. He continued this three-day pattern throughout the month.



   a. How many times did Steve eat each kind of soup? Explain.

   b. If Steve wanted to build a table to show the total amount of grams of each nutrient he ate in April, how would all of the numbers in the table change in size?

   c. For how many days would Steve have to follow his three-day pattern so that the numbers in the table would represent the number of decagrams (dag) of each nutrient he ate? Explain.

   d. For how many days would Steve have to follow his three-day pattern so that the numbers in the table would represent the number of hectograms (hg) of each nutrient he ate? Explain.

e. For about how many years would Steve have to follow his three-day pattern so that the numbers in the table would represent the number of kilograms (kg) of each nutrient he ate? Explain.

Check your answers on pages 84 and 85 in the Appendix.

The following table shows the nutritional information listed on a bag of cheese snacks. Use this information to answer questions 3 to 5.

CHEEZ
curlz

Nutrient	Amount Per 28-g Serving
Protein	1.7 g
Fat	12 g
Carbohydrates	13 g
Dietary Fibre	0.4 g
Sodium	440 mg
Potassium	79 mg

3. Copy and complete the following table in your notebook to show the number of grams of each nutrient in a 280-g bag of cheese snacks.

Nutrient	Grams Per 280-g Bag
Protein	
Fat	
Carbohydrates	
Dietary Fibre	
Sodium	
Potassium	

4. Use and explain a method to estimate about how many 28-g servings of cheese snacks you would have to eat to consume 1 g of potassium.

5. About how many 280-g bags would you have you eat to consume 1 kg of fat? Explain.

Check your answers on pages 85 and 86 in the Appendix.

Use the following information to answer questions 6 to 8.

To prepare a 224-g box of macaroni and cheese, you boil the macaroni in water, drain it, add 45 mL of butter and 50 mL of 2% milk, and then you mix in the cheese powder. This makes four 175-mL servings of macaroni and cheese. The following table shows the nutrition information given on the 224-g box. The dry ingredients include the macaroni and the cheese powder.

Nutrient	Grams Per 175-mL Serving of Dry Ingredients	Grams Per 175-mL Serving of Prepared Macaroni and Cheese
Protein	7.7	8.2
Fat	2.1	9.6
Carbohydrates	38	39

6. a. You have been told that one box makes four servings of macaroni and cheese, but how can you prove this is true from the information given?

b. Copy and complete the following table in your notebook to show the number of grams of each nutrient for the whole 224-g box.

Nutrient	Grams Per Whole Box of Dry Ingredients	Grams Per Whole Box of Prepared Macaroni and Cheese
Protein		
Fat		
Carbohydrates		

7. There are more nutrients in the prepared macaroni and cheese than there are in just the dry ingredients because of the nutrients in the butter and milk that you add. In fact, 250 mL of 2% milk contains 5.0 g of fat. If so, how many grams of the fat in the whole box of prepared macaroni and cheese comes from

   a. just the milk? Explain. **b.** just the butter? Explain.

8. Explain your estimate to decide about how many whole boxes of prepared macaroni and cheese would have 1 kg of

   a. protein **b.** fat **c.** carbohydrates

Check your answers on pages 86 and 87 in the Appendix.

9. Tom loves ravioli. He eats one 425-g can of it every day. He said that he probably ate a tonne of it last year. Explain how you can make an estimate to show if this is likely.

10. Eeny said he bought 0.5 kg of popcorn, Meeny said she bought 35 dag of popcorn, Miny said she bought 4 hg of popcorn, and Mo said he bought 300 g of popcorn. Who bought the most popcorn? Explain.

Question 11 is optional. Do this question if you need more practice.

11. A farmer was packaging his potatoes for sale, but had to discard 10% of the potatoes he harvested because of spoilage.

    a. Find the mass of potatoes that the farmer could sell for every tonne of potatoes that he harvested.

    b. How many 10-kg bags of potatoes could the farmer package for sale from each tonne of potatoes that he harvested?

Check your answers on pages 87 and 88 in the Appendix.

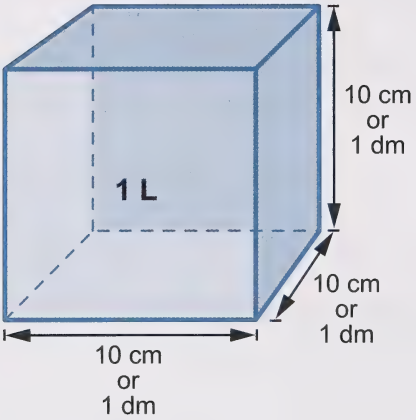
Activity 3

Today you will investigate how volume is measured in the metric system.

Units of volume and capacity can both be used to measure how much space is occupied by a solid or how much space there is inside a container. All measures given in units of capacity can be expressed in units of volume and vice versa.

Liquids are usually measured with units of capacity; solids are usually measured with units of volume. The basic metric unit for capacity is the **litre**.

A litre is the volume of a cube that measures 10 cm (1 dm) on each side.



$$1\text{ L} = 10\text{ cm} \times 10\text{ cm} \times 10\text{ cm}$$
$$= 1000\text{ cm}^3$$

or

$$1\text{ L} = 10\text{ cm} \times 10\text{ cm} \times 10\text{ cm}$$
$$= 1\text{ dm} \times 1\text{ dm} \times 1\text{ dm}$$
$$= 1\text{ dm}^3$$

The following table shows how the units for capacity and volume are related. The most commonly used units of capacity and volume are shown in bold. Capacity and volume units in the same rows in the table are equivalent.

Capacity			**Volume**	
Number of Litres	**Unit**	**Symbol**	**Unit**	**Symbol**
1000 L	**1 kilolitre**	**1 kL**	**1 cubic metre**	**1 m^3**
100 L	1 hectolitre	1 hL	—	—
10 L	1 decalitre	1 daL	—	—
1 L	**1 litre**	**1 L**	**1 cubic decimetre**	**1 dm^3**
0.1 L	1 decilitre	1 dL	—	—
0.01 L	1 centilitre	1 cL	—	—
0.001 L	**1 millilitre**	**1 mL**	**1 cubic centimetre**	**1 cm^3**

The following table lists milk prices from Sunshine Dairy. Use this information to answer questions 1 to 4.

	Cost ($)		
Size	**1% Milk**	**2% Milk**	**Homo Milk**
250 mL	0.52	0.53	not available
500 mL	not available	0.88	0.90
1 L	1.15	1.17	1.19
2 L	2.23	2.25	2.29
4 L	4.29	4.29	4.29

1. Ms. Brown needs 1.5 L of 2% milk.
   - **a.** Find all the ways she could buy exactly this amount.
   - **b.** Which is the most economical way? Explain.
   - **c.** Which is the least economical way? Explain.

Questions 2 to 4 are optional. Do these questions if you had difficulty with question 1.

SUNSHINE
DAIRY

2. Mr. Green needs 1.25 L of 1% milk, 2.75 L of 2% milk, and 1.5 L of homo milk. What is the most economical way he can do this? Explain.

3. Miss Grey needs 1.75 L of 2% milk. What is the most economical way she can do this? Explain.

4. Each day of the summer, each of the three Reed children bought a 250-mL carton of 1% milk for lunch. At the end of summer, Mrs. Reed said that if each of the children had taken a container of milk that could be filled at home, they would have spent only half of what they did on milk. Do you agree?

Check your answers on pages 88 and 89 in the Appendix.

5. After her dad filled his car with gas, Shannon recorded that this fill-up was 44.384 L in the gas log. She noticed that the previous fill-up was 43.53 L. How many more millilitres did he need this time than the previous time? Explain.

6. The gas tank on Greg's car holds 50 L. If he uses about a tank of gas every two weeks, how many kilolitres of gas would he use in a year?

7. Every house has a water meter that registers the total amount of water used over time. At the end of June, Janice's water meter reading was $7590.0\ \text{m}^3$. At the end of July, the reading was $7638.3\ \text{m}^3$.

   a. How many kilolitres of water did Janice's family use in July?

   b. About how many litres of water did Janice's family use each day?

8. Shovels, each with a capacity of $5.5\ \text{dm}^3$, were used to dig a hole for a pond. Two thousand shovelfuls of dirt were taken out.

   a. Find the total volume of the dirt removed in cubic decimetres and in cubic metres.

   b. Find the capacity of the pond in litres and in kilolitres.

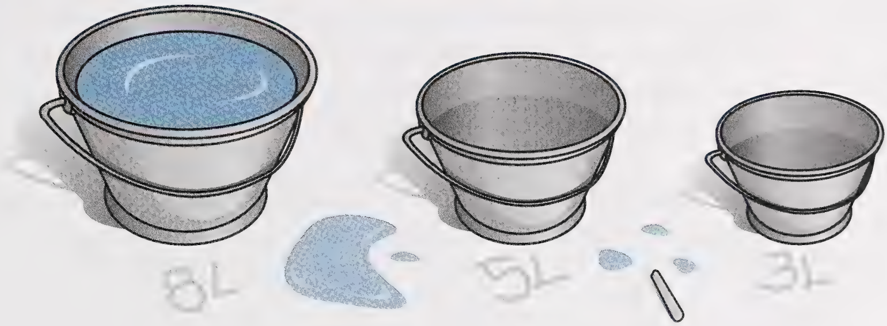
9. In Canada, capacities of containers that are less than 1 L are usually shown in millilitres. In France, however, the decilitre is also used. Give the following capacities in decilitres.

   a. a small juice box with a capacity of 200 mL
   b. a 500-mL bottle of pop
   c. a 350-mL can of cherries

10. Is it correct to write units of capacity with a raised 3 (for example, L^3 or mL^3)? Explain.

Check your answers on pages 89 and 90 in the Appendix.

Challenge Activity



Johan has an 8-L pail full of water, but he needs only 4 L of water. He also has two empty pails, a 3-L pail and a 5-L pail. None of the pails have capacity markings on them.

1. Use a table similar to the one below to show how Johan can measure out exactly 4 L of water using the pails he has. (Assume that no water gets spilled.)

Step	Description	Water in Each Pail (L)		
		8-L Pail	5-L Pail	3-L Pail
0	Start with the 8-L pail full. (The others are empty.)	8	0	0
1				
2				
3				

2. What is the least number of steps Johan can use to measure exactly 4 L of water? Show your work.

Check your answers on page 91 in the Appendix.

Conclusion

In this lesson you reviewed the most commonly used measurements and symbols for length, mass, volume, and capacity. You learned how to express the same measures using different units. You used these related units to solve problems.

It is important to know how to calculate measurements accurately. You saw how just a slight miscalculation can cause disastrous results, particularly when dealing with vast distances in space.

It is also important to your health to know and be able to visualize certain measures, such as those used for nutrients in the foods you eat.

Turn to Assignment Booklet 5A and complete
the Lesson 1 Assignment.

Keep Assignment Booklet 5A until you have completed the entire booklet.

Lesson 2

Perimeter and Area

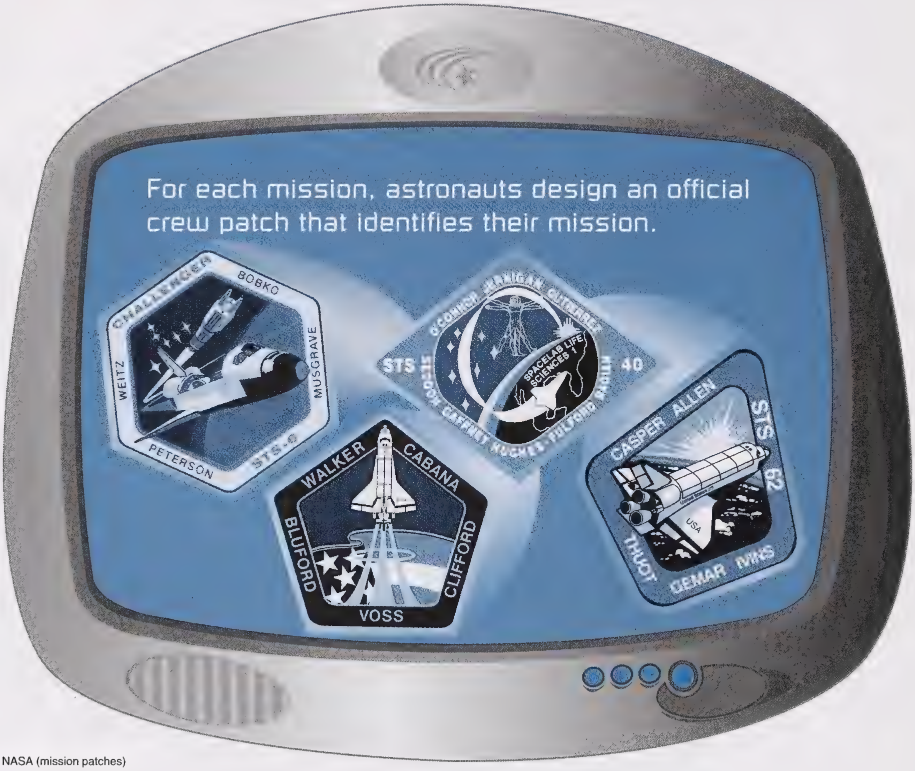
ALBERTA AGRICULTURE, FOOD AND RURAL DEVELOPMENT

If you were to look down at the prairie farm landscape from an aircraft, you would see a patchwork of fields and roads. These east-west roads and north-south roads enclose areas of land that are usually 1 mile (about 1.6 km) by 2 miles (about 3.2 km) in size.

How would the perimeter and area of these rectangular portions of land be described in the metric system? In this lesson you will develop rules for finding the perimeters of polygons and the areas of rectangles. You will explore the metric units for perimeter and area. You will also use the relationship between perimeter and area to solve problems.

Activity 1

Today you will explore the perimeter of **polygons**.



For each mission, astronauts design an official crew patch that identifies their mission.

CHALLENGER
BOBKO
MUSGRAVE
WEITZ
PETERSON
STS-6
WALKER
CABANA
BLUFORD
CLIFFORD
VOSS
STS
40
O'CONNOR
JERNIGAN
GUTIERREZ
SPACELAB LIFE SCIENCES 1
SEDDON
GAFFNEY
HUGHES-FULFORD
BAGIAN
CASPER
ALLEN
STS 62
THUOT
GEMAR
IVINS
USA

NASA (mission patches)

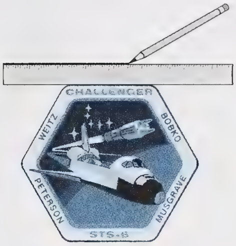
A patch for each space mission is created by the crew of astronauts. They may design the patch themselves or commission a professional artist to do it. The design incorporates themes they would like to see associated with their mission.

If you have access to the Internet, you can find more patches at the following website:

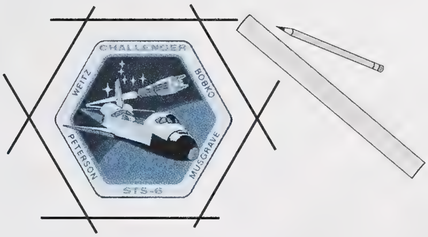
http://galacticvoyager.com

Evan collects souvenir patches from the space shuttle missions. He especially likes the ones that are shaped like polygons because he can make display frames that match the shapes of those patches. To make a frame, Evan puts the patch on a sheet of paper and follows these steps:

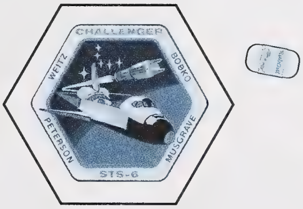
Step 1: He places his ruler along one side and draws a line.


CHALLENGER
WEITZ
BOBKO
PETERSON
MUSGRAVE
STS-6

Step 2: He repeats this along each side of the patch.


CHALLENGER
WEITZ
BOBKO
PETERSON
MUSGRAVE
STS-6

Step 3: He erases the ends past where the lines intersect. This leaves the polygon frame.

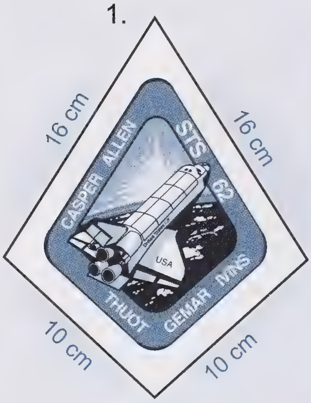

CHALLENGER
WEITZ
BOBKO
PETERSON
MUSGRAVE
STS-6

Step 4: To find how much framing material he needs to buy for each patch, Evan measures the perimeter of the frame he drew.

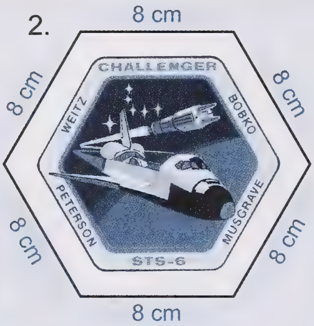
Perimeter is the distance around a figure.

The following pictures show how Evan framed and displayed nine of his patches. Use these pictures to answer questions 1 to 9.

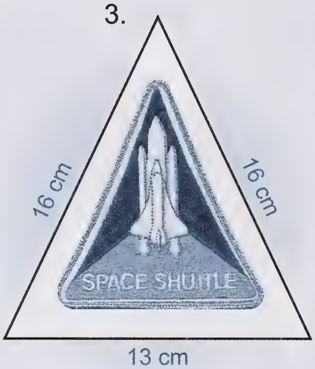
1.


16 cm
16 cm
10 cm
10 cm
CASPER ALLEN
STS 62
THUOT GEMAR IVINS
USA

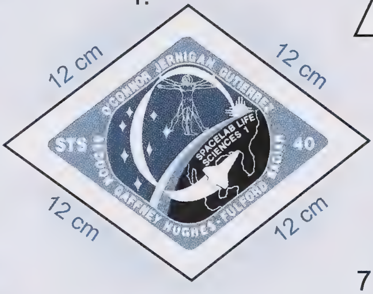
2.


8 cm
8 cm
8 cm
8 cm
8 cm
8 cm
CHALLENGER
WEITZ
BOBKO
PETERSON
MUSGRAVE
STS-6

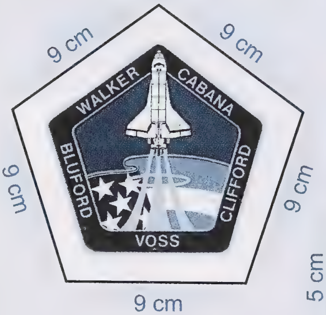
3.


16 cm
16 cm
13 cm
SPACE SHUTTLE

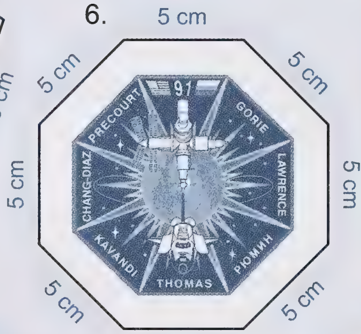
4.


12 cm
12 cm
12 cm
12 cm
O'CONNOR JERNIGAN GUTIERREZ
STS 40
SPACELAB LIFE SCIENCES 1
GAFFNEY HUGHES-FULFORD

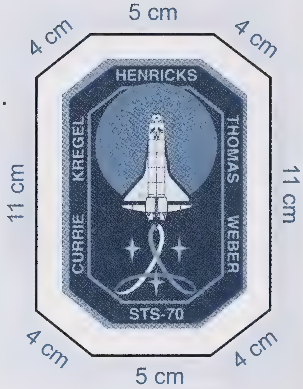
5.


9 cm
9 cm
9 cm
9 cm
9 cm
WALKER
CABANA
BLUFORD
CLIFFORD
VOSS

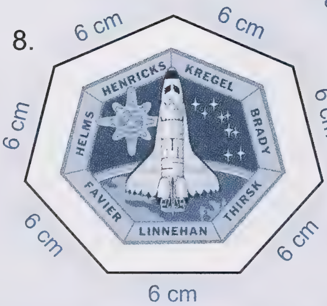
6.


5 cm
5 cm
5 cm
5 cm
5 cm
5 cm
5 cm
5 cm
91
PRECOURT
GORIE
CHANG-DIAZ
LAWRENCE
KAVANDI
THOMAS
РЮМИН

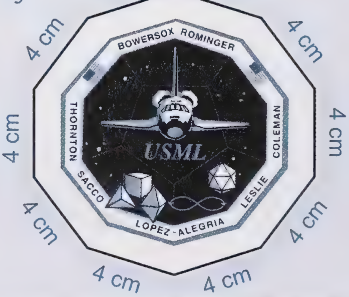
7.


5 cm
4 cm
4 cm
11 cm
11 cm
4 cm
4 cm
5 cm
HENRICKS
KREGEL
THOMAS
CURRIE
WEBER
STS-70

8.


6 cm
6 cm
6 cm
6 cm
6 cm
6 cm
6 cm
HENRICKS
KREGEL
HELMS
BRADY
FAVIER
THIRSK
LINNEHAN

9.


4 cm
4 cm
4 cm
4 cm
4 cm
4 cm
4 cm
4 cm
4 cm
BOWERSOX ROMINGER
THORNTON
COLEMAN
USML
SACCO
LESLIE
LOPEZ-ALEGRIA

NASA (mission patches)

Copy and complete the following table by naming the polygon shape for each of Evan's patches and showing two ways to find its perimeter. Use only addition in the first method.

	Name of Polygon	Method 1 to Find Perimeter (Addition)	Method 2 to Find Perimeter
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			

10. Write a rule you can use to find the perimeter of any figure.

11. For which of the polygons is it possible to find the perimeter using a single operation only once? Explain your answer.

12. a. For which patch did Evan need the least length of framing material?

b. For which patch did Evan need the greatest length of framing material?

c. Find the total length, in centimetres and metres, of framing material Evan needs for the nine patches shown.

Question 13 is optional. Do this question if you like a challenge!

13. Which frame would likely take Evan the greatest amount of time? Explain your thinking.

Check your answers on pages 92 and 93 in the Appendix.

Activity 2

Today you will explore how area is measured in the metric system.

WELCOME
First Class Mail
FRAGILE
HOTEL REGINA
VIENNA
METROPOLE

Area is the number of square units needed to cover a surface.

The following table shows how SI prefixes apply to measuring area. Each unit equals 100 of the unit listed just below it. The most commonly used units of area are shown in bold.

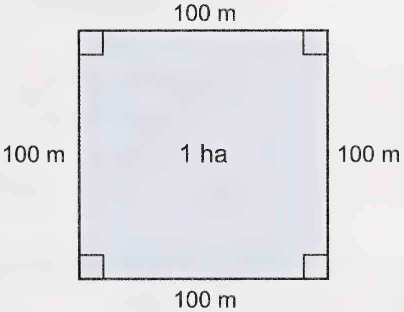
Unit	Symbol	Number of Square Metres	Example of That Approximate Area
square kilometre	**$1\,km^2$**	$1\,000\,000\ m^2$	a farmer's field
square hectometre	**$1\,hm^2 = 1\,ha$**	$10\,000\ m^2$	a CFL football field
square decametre	$1\ dam^2 = 1\ a$	$100\ m^2$	a school classroom
square metre	**$1\,m^2$**	$1\ m^2$	the top of a desk
square decimetre	$1\ dm^2$	$0.01\ m^2$	a CD case
square centimetre	**$1\,cm^2$**	$0.0001\ m^2$	a key on a keyboard
square millimetre	**$1\,mm^2$**	$0.000\,001\ m^2$	a dot with a blunt pencil

Some countries call the square decametre an **are** (a), which is pronounced "air." Although the are and the hectare are metric units, they were not adopted as official SI units.

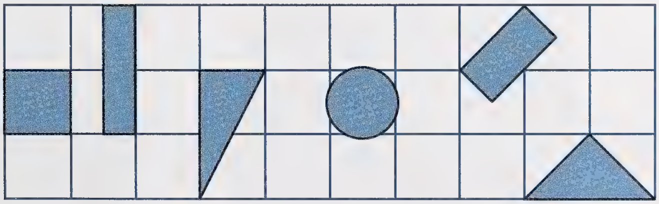
- $$\begin{aligned} 1\text{ a} &= 10\text{ m} \times 10\text{ m} \\ &= 100\text{ m}^2 \end{aligned}$$
- $$\begin{aligned} 1\text{ ha} &= 100\text{ m} \times 100\text{ m} \\ &= 10\,000\text{ m}^2 \end{aligned}$$

Therefore, $1\text{ ha} = 100\text{ a}$.

The square hectometre is often called a **hectare** (ha). One hectare is equal to $10\,000\text{ m}^2$. In Canada, you will hear the word *hectare* used to describe large areas, such as the sizes of fields or areas destroyed by forest fires. One hectare is the area of a square that measures 100 m on a side.

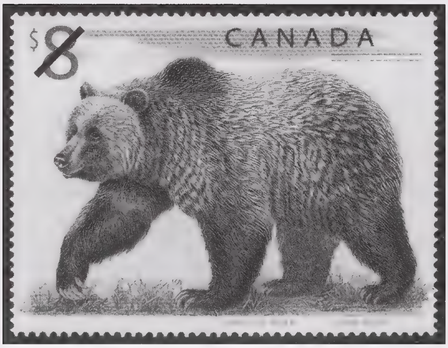


Note that a figure that has an area of 1 square unit does not have be in the shape of a square—it can be any shape. For example, each of the following figures has an area of 1 cm^2.



Rectangles are used in everyday life. Just look around and you will see many different examples of them. Because rectangles come in many different sizes and proportions of length to width, you might be able to decide which is larger or smaller by comparing dimensions, but at other times you may need to find their areas.

Matthew collects stamps for a hobby. He read that the largest Canadian stamp ever made measured 64 mm by 49 mm. This $8 stamp was issued in 1997 and featured the grizzly bear.



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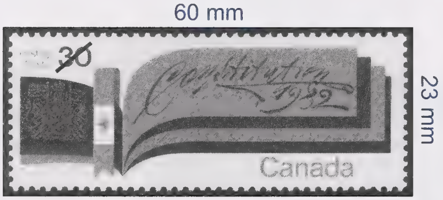
Matthew wondered which of the stamps in his collection was the largest. He used estimation to choose the four stamps that looked the largest, and then he measured them. Use the information for Matthew's stamps to answer questions 1 to 4.


60 mm
23 mm
30
Constitution 1982
Canada

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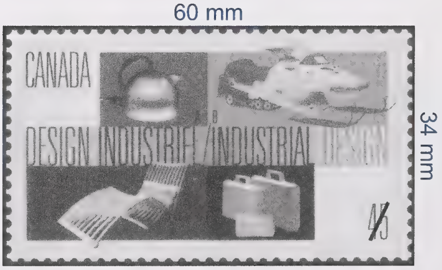
60 mm
34 mm
CANADA
DESIGN INDUSTRIEL/INDUSTRIAL DESIGN

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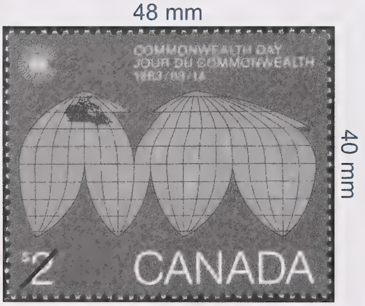
48 mm
40 mm
COMMONWEALTH DAY
JOUR DU COMMONWEALTH
1983/03/14
$2
CANADA

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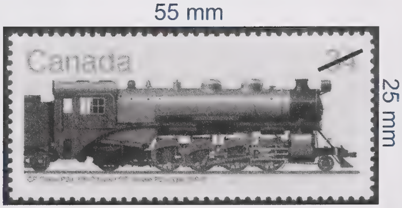
REPRODUCED WITH PERMISSION.


55 mm
25 mm
Canada

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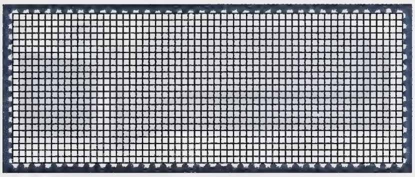
1. Which of these four stamps can Matthew be sure is **not** the largest just by comparing its dimensions with the other stamps? Explain.

2. To find the area of the 1982 Constitution stamp, Matthew thought of the area of the stamp as a 60-by-23 array of squares.



   a. How many squares are there in the array? Explain.
   b. What is the area of each square in the array?
   c. What is the area of the Constitution stamp? Explain.

3. Use Matthew's method from question 2 to find the area of the following stamps.

   a. the 1983 Commonwealth Day stamp
   b. the 1985 locomotive stamp
   c. the 1992 industrial design stamp
   d. the 1997 grizzly bear stamp

Question 4 is optional. Do this question if you need more practice.

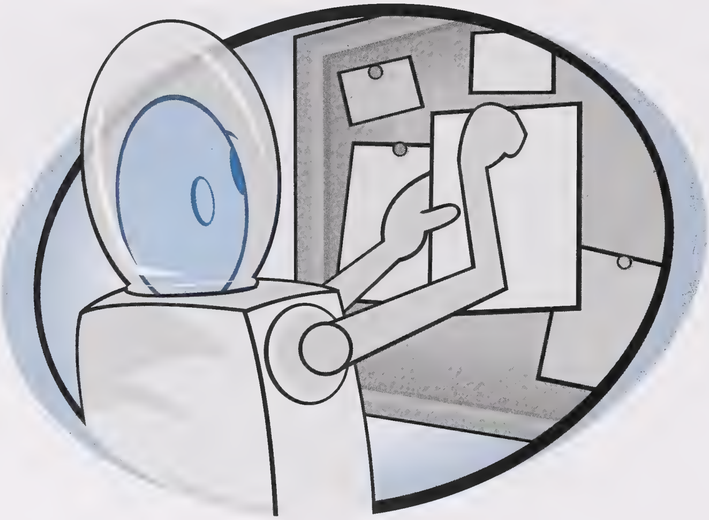
4. a. Which of Matthew's stamps has the greatest area?

   b. How much larger is the area of the grizzly bear stamp than Matthew's largest stamp? Show your work.

   c. A stamp Matthew would like to add to his collection is the 1988 Winter Games stamp. This stamp is half the area of the grizzly bear stamp. How many more square millimetres larger is the grizzly bear stamp than it? Explain.

Check your answers on pages 93 and 94 in the Appendix.

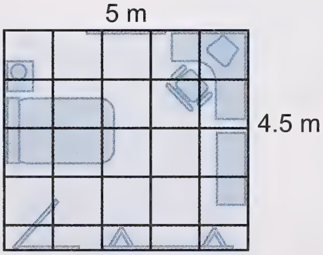
5. Perry needs a bulletin board to put on the wall over his desk. The office-supplies store has the following sizes of rectangular bulletin boards: 45 cm by 60 cm, 40 cm by 75 cm, 50 cm by 55 cm, and 35 cm by 65 cm. Perry wants to buy the bulletin board with the greatest surface area.



   a. What rule can Perry use to find the area of each bulletin board?

   b. Find the bulletin board with the greatest surface area. Show your work.

6. Drina wants to buy an area rug for her bedroom, which measures 4.5 m by 5 m. She drew and labelled a picture of her room.



   a. What area is represented by each square in the picture?

   b. How many whole squares are in the picture?

c. What fraction of a whole square is each rectangle in the bottom row?

d. Show how you can find the area of Drina's room by using a counting method.

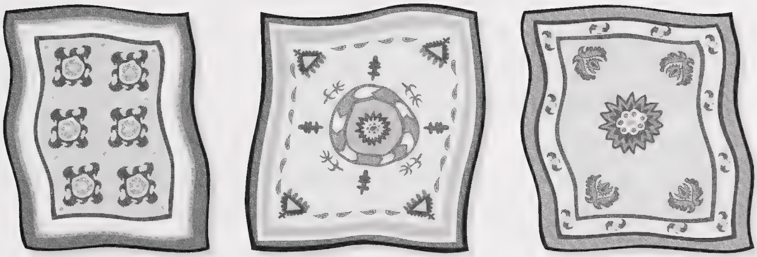
e. Show how you can use your rule from question 5.a. to find the area.

DRINA'S
ROOM

7. Drina saw some area rugs for sale. She liked the patterns on the three rugs that were 4 m by 4.8 m, 4 m by 5 m, and 3 m by 5.4 m.

   a. Find the area of each of the three rugs. Show your work.

   b. Drina said that she can use any of these rugs because their areas are all less than the area of her room. Do you agree with her? Explain.



Questions 8 and 9 are optional. Do these questions if you need more practice.

8. Parkdale Town Council wants to build a new park that has an area of about 10 ha. The park will have a soccer field, a playground, and a picnic area. There are three suitable locations available: a 3 hm by 3.5 hm lot, a 3 hm by 5.3 hm lot, and a 1 hm by 10 hm lot.

a. Find the area, in hectares, of each of the three lots.
b. Which of the three lots best meets the needs for the park? Explain.

9. One of the three following reports about a forest fire is incorrect.

- The newspaper stated that almost 64 ha of forest were destroyed by the fire.
- The television newscast said that the fire destroyed an area of 35 km^2.
- The radio reported that the area destroyed was a square with a length of about 6 km.

Which report is incorrect? Explain why.

Check your answers on pages 94 and 95 in the Appendix.

Activity 3

Today you will apply your skills to solve problems involving perimeter and area.

Leslie and Lambert are setting up the community hall for a youth club party. They want to make large rectangular tables by putting 12 small square tables together.

1. Use square tiles or pattern blocks to represent the small tables. Find all the ways they can put 12 small square tables together to make one large rectangular table (with no gaps on the top surface). Draw pictures to show your solutions.

2. Leslie and Lambert want to put a decorative border around the edge of each large table they make.

   a. Do you think they will need the same amount of border for each table? Explain your thinking.

   b. If the small tables have sides of 1 m, find how much border they need for each large table. Explain how can you use the tiles to find your answer.

3. **a.** Use the terms *area* and *perimeter* to describe how all the table arrangements you made are the same in one way yet different in another way.

   b. Explain how the shapes of the tables change as their perimeters change.

4. **a.** Describe ways Leslie and Lambert might need to use the tables at the party.

   b. Explain how the relationship between area and perimeter can help them decide the best way to arrange the tables.

5. Now relate the perimeter and area of the tables to factors and multiples.

   a. List the dimensions of all the large tables made by putting 12 small tables together.

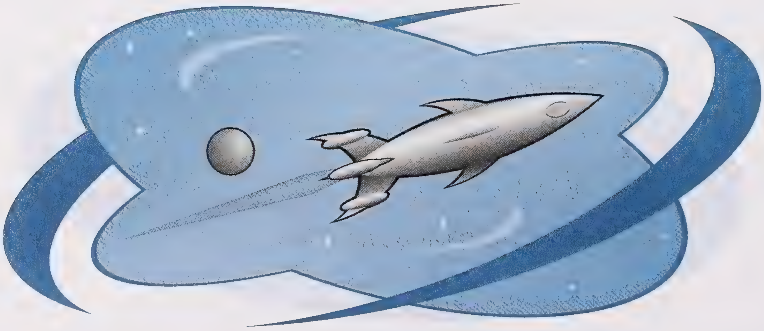
   b. How is each of these pairs of numbers related to 12? What are these numbers called?

Question 6 is optional. Do this question if you had difficulty with question 5.

6. **a.** Explain how you can use 30 tiles to find all the factors of 30.

   b. Use 30 tiles to find all the factors of 30. Draw pictures to show your work.

   c. List all the factors of 30.



7. For their meeting, the youth club needed to use the 1-m^2 tables to make a large rectangular table with a perimeter of 24 m.

   a. Use tiles to find all the ways they could do this. Draw pictures to show your work.

   b. What is the least number of tables that they could use? What is the greatest number of tables they could use?

   c. Explain how the shapes of the tables change as their areas change.

Question 8 is optional. Do this question if you need additional practice.

8. If you were given a length of decorative border, explain how you could find the greatest rectangular area that you could enclose with it.

Check your answers on pages 95 to 97 in the Appendix.

Sharing Time

Now it's time to show your home instructor what you have been learning.

Turn to page 116 of the Practice and Homework Book and complete questions 1 and 2.

Your home instructor will help you check your answers.

Challenge Activity

A rectangular garden has a perimeter of 36 m and its area is larger than 50 m^2.

1. If the measures of the sides are in whole metres, draw all the possible rectangles. Explain the strategy you used to decide on possibilities.

2. If half-metre measures are permitted for the lengths of the sides, find a rectangle that has a perimeter of 36 m and an area as close as possible to 50 m^2.

Check your answers on page 98 in the Appendix.

Conclusion

In this lesson you reviewed and extended your understanding of perimeter and area. You developed rules for finding the perimeters of polygons and the areas of rectangles. You used the relationship between perimeter and area to solve problems. You also explored where perimeter and area are used in everyday situations.

Do you live on a farm or have relatives that do? When settlers came to Western Canada in the late nineteenth and early twentieth centuries, most settled on homesteads that were square areas of land called *quarter sections*. Each was one-quarter of a section of land—a square that measures one-half mile on each side. In the metric system these quarter sections would be a little over 800 m on each side, or approximately 64.7 ha in area.

Turn to Assignment Booklet 5A and complete the Lesson 2 Assignment.

When you are done, submit Assignment Booklet 5A to your teacher to be marked.

Lesson 3

Surface Area and Volume

When you were a small child, did you ever crawl inside and hide in a large cardboard box? Some children cut small holes in the sides of the box so they can look out at the world around them without being seen! If you were to do this today, what size of a box would you need? What would its area and volume be? If an adult asked you what you were doing, you could always say you are exploring **rectangular prisms**, which is another way of describing a shape that looks like a cardboard box!

In this lesson you will review and extend your understanding of rectangular prisms. You will learn how to find the surface area and develop a rule for finding the volume of a rectangular prism. You will use these procedures to solve a variety of problems.

Activity 1

Today you will explore surface area.

What a thrill to watch the solar array blanket unfold like an accordion.

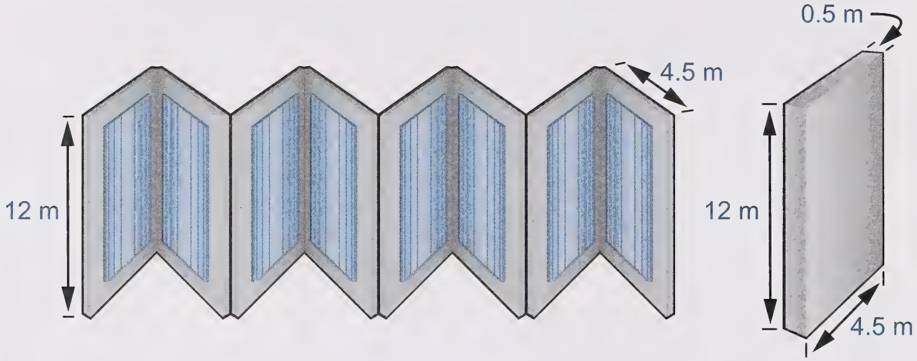
NASA

Astronaut Joseph R. Tanner, mission specialist, signals "thumbs-up" during his extravehicular activity to perform work on the International Space Station.

In December 2000, Canadian astronaut Marc Garneau used the Space Shuttle's robotic arm to manoeuvre two solar array panels that each measured about 36 m long. They came bundled accordion-like in a box attached to the International Space Station.

Use the following information to answer questions 1 to 4.

Solar panels have been used to provide power for spacecraft since the beginning of the space age. Each panel is like a "blanket" that folds up to be transported inside a solar array blanket box (SABB). The approximate dimensions of the SABB for a 36-m-long ISS solar array panel were 4.5 m long, 12 m wide, and 0.5 m thick.



The SABB is an example of a rectangular prism. The surface area of this box is the surface area of a prism.

The **surface area of a prism** is the sum of the areas of all its faces.

1. **a.** How many faces does the SABB have? What shape are they?
   b. What are the dimensions of each face?

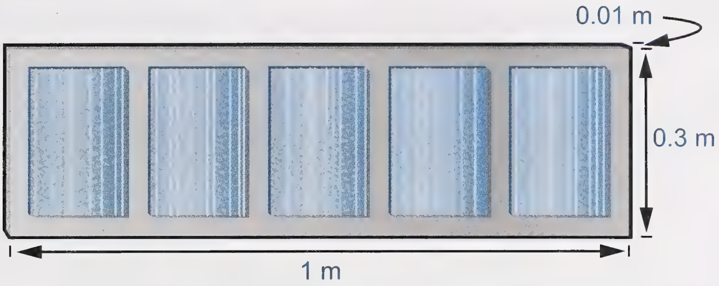
2. Draw a net of the SABB you described in question 1. The net you draw should be like a miniature model of the life-size net of the SABB. Label the dimensions of the SABB (in metres) on your net.

3. Estimate the total surface area of the SABB.

4. **a.** Find the area of each face of the SABB. Show your work.
   b. Find the surface area of the entire SABB. Show your work.

Check your answers on page 99 in the Appendix.

A small unfolded solar panel is shown in the following picture. Use this information to answer questions 5 to 8.



5. Use base ten flats to make a life-size model of the panel. If you run out of flats, you may use repeated tracings of a flat on a sheet of newspaper. Draw a picture of your model on a sheet of paper, showing all of the separate flats, and label the dimensions in centimetres.

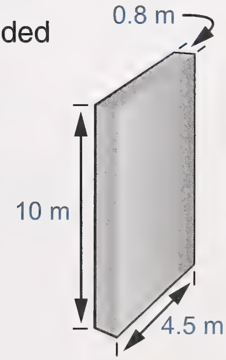
6. Find the surface area, in square centimetres, of your model of the unfolded solar panel (from question 5). Show your work.

Questions 7 and 8 are optional. Do these questions if you need extra practice with the ideas of this activity.

7. The solar panel can be folded to one-tenth of its length, forming a right rectangular prism the size of its SABB. Use base ten blocks and flats to make a life-size model of the SABB. What are the dimensions, in centimetres, of your model of the SABB?

8. Find the surface area, in square centimetres, of the module of the SABB in question 7. Show your work.

A solar panel fits snugly in the SABB shown after being folded like an accordion to $\frac{1}{8}$ of its length. Use this information to answer questions 9 and 10.



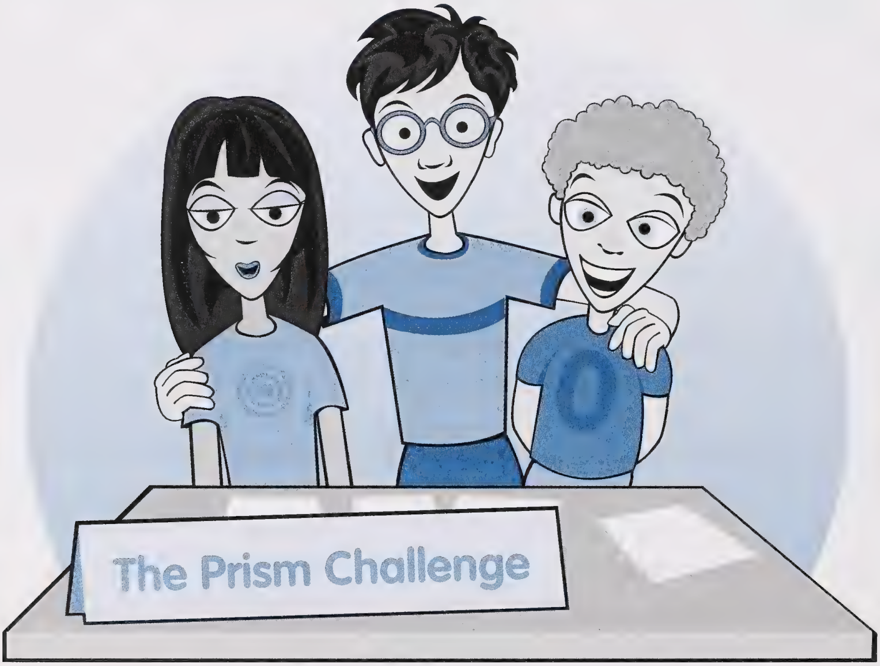
9. a. Estimate the surface area of the SABB. Show your work.
b. Find the surface area of the SABB. Show your work.

10. a. What are the dimensions of the panel when it is unfolded?
b. What is the area of its largest face?

Check your answers on pages 100 to 102 in the Appendix.

Activity 2

Today you will investigate rectangular prisms and their surface area.

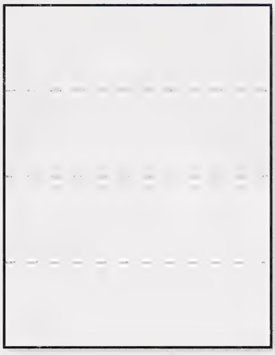


Izak, Rob, and Sara entered a contest that challenged them to make the largest possible right rectangular prism out of a standard 28 cm by 21.6 cm (8.5" by 11") sheet of paper. Use three sheets of paper to make Izak's, Rob's, and Sara's prisms as shown on the following pages.

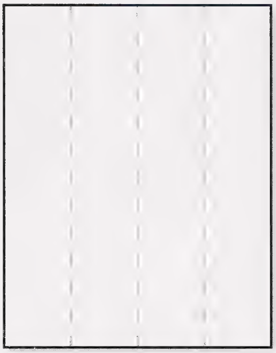
Rob and Izak used similar strategies.

Step 1: Rob and Izak began by folding their sheets into four equal parts.

Rob folded his horizontally.

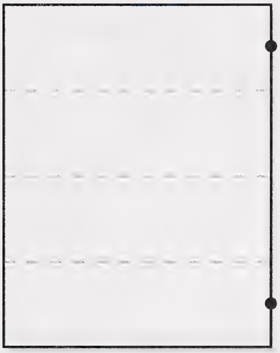


Izak folded his vertically.

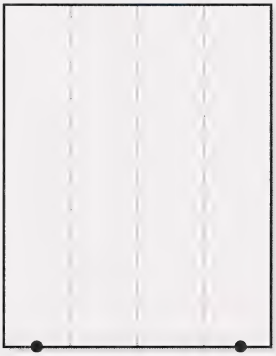


Step 2: They folded the edges of the end rectangles and marked the midpoints.

Rob

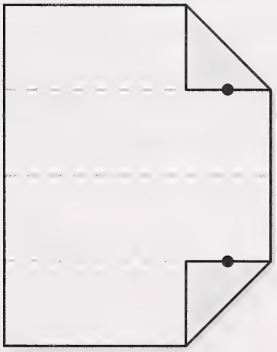


Izak

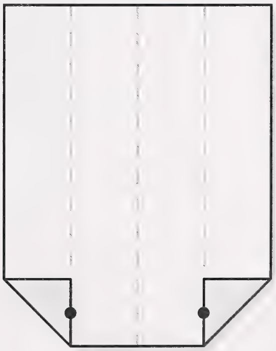


Step 3: They folded the corners and made dots where the midpoint marks fell.

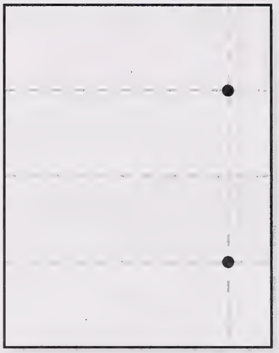
Rob

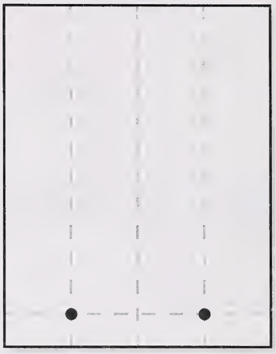


Izak

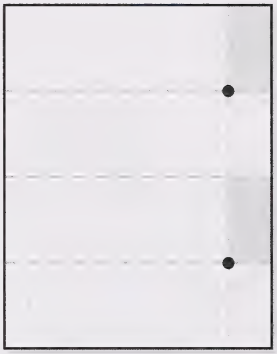


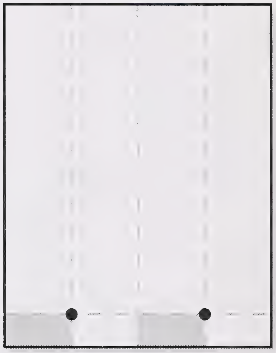
Step 4: They drew a line through the dots right to the edges of the paper and then folded the paper along that line.


Rob

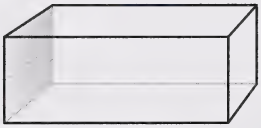

Izak

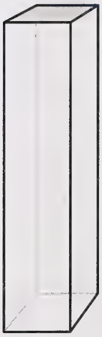
Step 5: They cut out the shaded rectangles and saved them for use in Step 6.


Rob


Izak

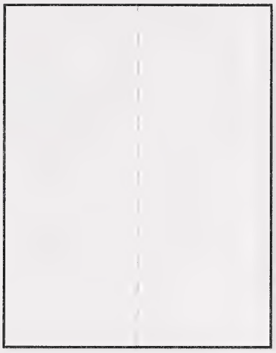
Step 6: They each folded their paper and taped it to make a hollow right rectangular prism. They folded the tabs to make one base and taped the two cut-out pieces to make the other base.


Rob

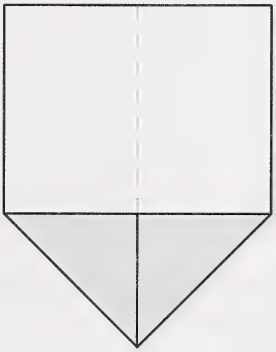

Izak

Sara's strategy is shown in the following steps.

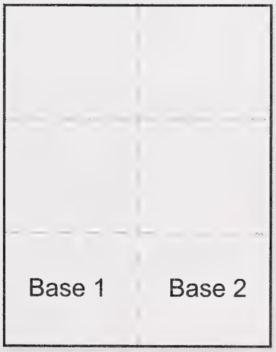
Step 1: She folded her sheet in half vertically.



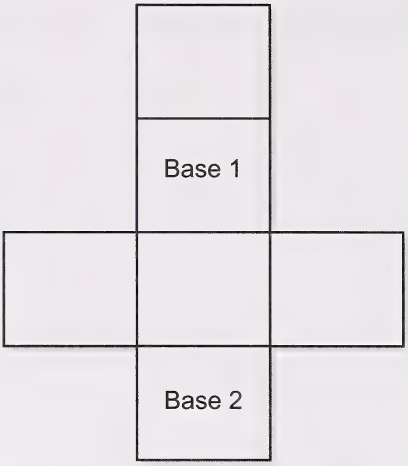
Step 2: She folded up the corners to make triangles and drew a line across the page. After unfolding, two squares are outlined. These squares will be the bases of her prism.



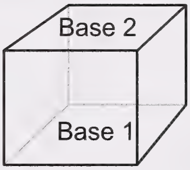
Step 3: She folded the rest of the page into four equal parts.



Step 4: She cut apart the rectangles and taped them to form a net.



Step 5: She folded her net to make a right rectangular prism as shown.

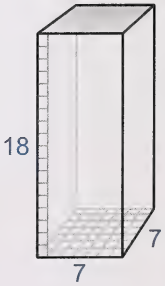


1. Compare the amount of surface area on Rob's, Isak's, and Sara's rectangular prisms.

2. Predict whether or not the volumes of all three rectangular prisms will be equal. Explain.

Check your answers on page 102 in the Appendix.

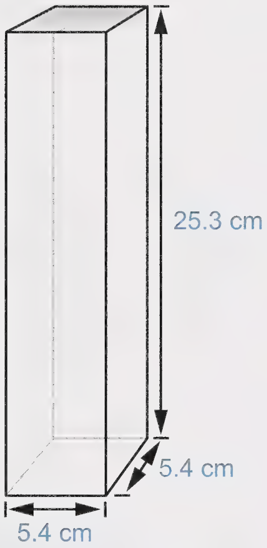
Rob used centicubes to find the volume of his prism. He made a 7-by-7 array of centicubes in the base of his prism and then stacked 18 centicubes to show he could make 18 such layers.



3. Find the volume of Rob's prism in cubic centimetres. Explain.

4. Rob said that he could find the volume of his prism by measuring its length, width, and height in centimetres and then multiplying them together. Do you agree with Rob? Explain.

5. Izak measured the base of his prism. He found that it was a square whose sides were about 5.4 cm. He found that the height of his prism was about 25.3 cm.



   a. Use Rob's rule from question 4 to estimate the volume of Izak's prism. Explain your thinking.

   b. Use your calculator to find the volume of Izak's prism.

Check your answers on page 102 in the Appendix.

6. Compare the volumes of Rob's and Izak's prisms.

   a. Was your prediction in question 2 correct?

   b. Predict how the volume of Sara's prism will compare with Rob's and Izak's. Explain.

7. Use your paper model of Sara's prism and measure the following dimensions in centimetres.

   a. edges of the square bases **b.** height of the prism

Use your measurements from question 7 to answer question 8.

8. **a.** Estimate the volume of Sara's prism. Explain your thinking.

   b. Use your calculator to find the volume of Sara's prism.

   c. Compare your answers to your prediction in question 6.b. Was your prediction correct?

Question 9 is optional. Do it if you need more practice.

9. Compare the volumes of the three prisms.

   a. Describe the relationship you see between the surface area and the volume of a prism.

   b. How might the relationship between surface area and volume be used when designing packages, such as soap boxes?

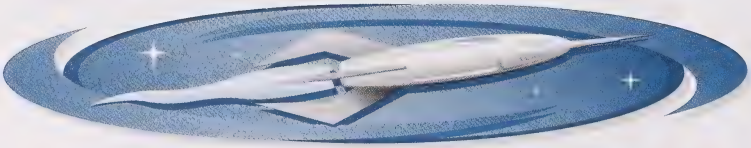
Check your answers on pages 102 and 103 in the Appendix.

Sharing Time

Now it's time to show your home instructor what you have been learning.

Turn to page 101 of the Practice and Homework Book and complete questions 1, 2, and 5.

Your home instructor will help you check your answers.



Activity 3

Today you will consider methods for measuring the volume of irregularly shaped objects.

24
2
4
6
8
10
12
14
16
18
20
22

What is the volume of the prize-winning pumpkin?

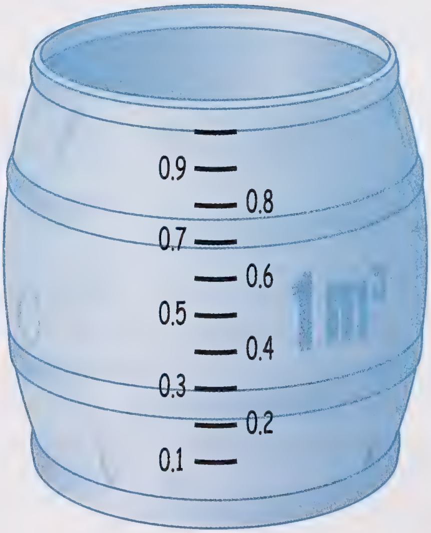
In Activity 2 you learned a rule for finding the volume of objects that are in the shape of right rectangular prisms. You can find the volume of many other geometric shapes by using their dimensions, but you need to use a different strategy to find the volume of objects that have irregular shapes. One strategy you can use is called **water displacement**.

When an object that does not dissolve or absorb water is completely submerged in a container of water, it "pushes" water out of its way to make room for itself. The water displaced by the object has the same volume as the object. You can see this happen when the water level in the container rises.

Don and Phil entered the pumpkin-growing contest held at the Community Fall Fair. A prize would be given to whoever had the largest pumpkin. Before the pumpkins were put on the scale, Don felt confident that he had the winning pumpkin because his looked bigger than Phil's. Phil was amazed to discover that, although his pumpkin looked a bit smaller, it weighed 66 kg. Don's larger-looking pumpkin weighed only 58 kg.

Once the judge declared Phil's pumpkin the winner, they began to set up for the next activity, bobbing for apples. Unfortunately, the water level in the barrel was too low. Don suggested raising the water level in the barrel by dropping their pumpkins into the barrel.

The side of the 1.0-m^3 barrel had markings labelled like a metre-stick from the bottom to the top. Each marking going up the side of the barrel represents 0.1 m^3 of volume. Use this information to answer questions 1 to 5.



1. The barrel started with the water level exactly at the $0.6\ \text{m}^3$ level. When Phil's pumpkin was submerged in the barrel, the water level rose to exactly the $0.7\ \text{m}^3$ level.

   a. In your notebook, make a sketch of a barrel and draw the levels where the water was before and after Phil's pumpkin was submerged.

   b. Use the two water levels to find the volume (in cubic metres) and capacity (in litres) of Phil's pumpkin. Remember, $1\ \text{m}^3 = 1000\ \text{L}$.

2. When Don put his pumpkin in the barrel, the water rose to the $0.81\ \text{m}^3$ level.

   a. What was the volume and capacity of Don's pumpkin? Show your work.

   b. Whose pumpkin has the greater volume and capacity? By how much? Show your work. Express your answer for capacity in both litres and millilitres. Express your answer for volume in three different units.

   c. Based on your answers from question 2.b., do you agree with the judge's earlier decision to award Phil the prize for having the largest pumpkin? Explain.

3. The water level in the barrel was still too low to bob for apples. A third pumpkin with a capacity of 70 L was put in.

   a. What was the capacity of the third pumpkin in millilitres?

   b. What was the volume of the third pumpkin? Express your answer using three different units of volume.

   c. What was the new level of the water?

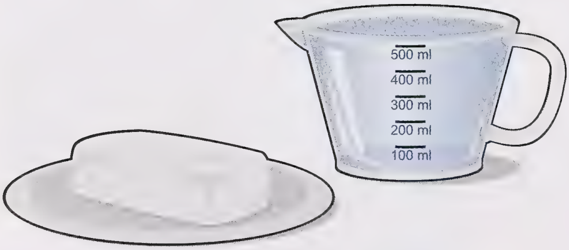
Check your answers on pages 103 and 104 in the Appendix.

4. A second identical water barrel was also used for bobbing for apples. It already had several large pumpkins submerged in it, so its water level was at the $0.94\ m^3$ level. It was agreed that more room was needed at the top of the barrel to float apples. When one pumpkin was removed, the water went down to the $0.85\ m^3$ level.

   a. What was the volume of the pumpkin that was removed? Express your answer in three different units of volume.

   b. What was the capacity of the pumpkin that was removed in litres and in millilitres?

5. Ms. Peters needs 200 mL of butter to make a pumpkin pie. Explain how she can use water displacement to measure that amount using a half-litre measuring cup that is marked from bottom to top every 100 mL.

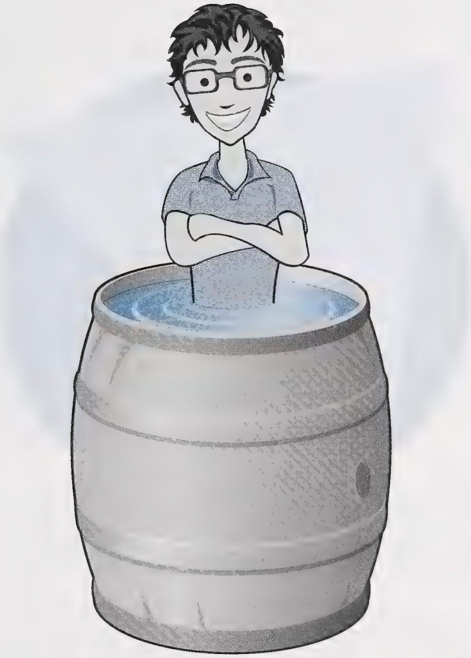


Questions 6 to 8 are optional. Do them if you like a challenge!

6. Velda needs to measure 125 mL of sugar, but she only has a 250-mL cup that is marked at the 125-mL level. She said she could use water displacement to measure her sugar. Do you agree with her? Explain.

7. Mr. Simon wants to make two pumpkin pies. His recipe calls for three large eggs. He has only three large eggs and several small eggs. Explain how he can use water displacement to find how many small eggs it would take to make one pie instead of using three large eggs.

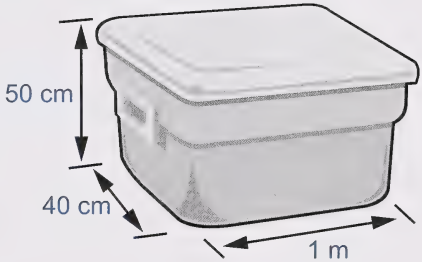
8. Jim stood in a barrel and the level of the water rose nearly to the top. He said that because the water level had risen by about 0.3 m^3, he knew that his total body volume must be that same amount. Do you agree with Jim? Explain.



Check your answers on page 105 in the Appendix.

Challenge Activity

An insulated foam camping cooler with its outside measurements is shown below. Use the information to answer questions 1 and 2.



1. How much room does the cooler occupy? (Express its volume in three different units.) Explain.

2. If each face is 4 cm thick, what is the capacity inside the cooler? (How much does it hold?) Explain and include a diagram with labelled dimensions.

3. What is the total volume of the foam used to make the cooler?

Check your answers on page 106 in the Appendix.

Conclusion

In this lesson you reviewed and extended your understanding of rectangular prisms. You learned how to find the surface area and develop a rule for finding the volume of a right rectangular prism. You used these procedures to solve problems.

When travelling by air, you are limited to the size of luggage that you can carry on the airplane. On most flights in Canada, you can carry on a small suitcase that measures no more than 55 cm by 40 cm by 23 cm. What is the volume of a suitcase that size?

Turn to Assignment Booklet 5B and complete
the Lesson 3 Assignment.

Keep Assignment Booklet 5B until you have completed the entire booklet.

Module Summary

In Module 5 you extended your understanding of measurement. You used the most common prefixes and symbols for multiples and fractions of metric units.

You reviewed and extended what you know about perimeter and area. You developed rules for finding the perimeters of polygons and the areas of rectangles. You used the relationship between perimeter and area to solve problems.

Also, you reviewed and extended your understanding of rectangular prisms. You learned how to find their surface area and volume. You used these procedures to solve problems.

The units of measurement are essential when describing space missions. Can you identify these units in the following paragraph?

The first person to orbit Earth was the Russian cosmonaut Yuri Gagarin. His mission on April 12, 1961, was completed in the spacecraft *Vostok 1*. *Vostok 1* was a small craft by today's standards. Weighing only 4750 kg, *Vostok 1* completed only one orbit of Earth—a distance of about 40 000 km in 108 min.

ARCHIVE MEDIA PROJECT/RUSSIA ARCHIVE ONLINE

Turn to Assignment Booklet 5B and complete the Numbers in the News project.

When you are done, submit Assignment Booklet 5B to your teacher to be marked.

Keystrokes

Take out your calculator and complete the following exercises. They will help you review some of the ideas you have learned in Module 5.

Funky Feature: Amazing Areas

In her landscaping business, Elien charges by the square metre to sod lawns, parks, and playgrounds. When calculating the areas she sodded for some recent jobs, she found a surprising pattern.

1. Use your calculator to find the following areas.

a.
68 m × 43 m
86 m × 34 m

b.
36 m × 42 m
63 m × 24 m

c.
21 m × 24 m
12 m × 42 m

2. What pattern do you see?

3. Now, use your calculator to find the following areas.

a. $$\begin{array}{r} 37\text{ m} \\ \times\, 42\text{ m} \\ \hline \end{array} \qquad \begin{array}{r} 73\text{ m} \\ \times\, 24\text{ m} \\ \hline \end{array}$$

b. $$\begin{array}{r} 48\text{ m} \\ \times\, 21\text{ m} \\ \hline \end{array} \qquad \begin{array}{r} 84\text{ m} \\ \times\, 12\text{ m} \\ \hline \end{array}$$

c. $$\begin{array}{r} 25\text{ m} \\ \times\, 41\text{ m} \\ \hline \end{array} \qquad \begin{array}{r} 52\text{ m} \\ \times\, 14\text{ m} \\ \hline \end{array}$$

4. What further conditions must you put in your pattern?

5. Make up some more examples that will follow the pattern, and then use your calculator to test your predictions.

Check your answers on page 107 in the Appendix.

Funky Feature: Rectangle Pattern

6. a. Use your calculator to find the areas of rectangles with the following dimensions.

31 m × 39 m = ____________ m^2

32 m × 38 m = ____________ m^2

45 m × 45 m = ____________ m^2

67 m × 63 m = ____________ m^2

b. In what two ways are the pairs of numbers being multiplied all alike?

c. How is the number formed by the tens and ones digits in each answer related to the ones digits in each pair of numbers being multiplied?

d. How is the number formed by the thousands and hundreds digits in each answer related to the tens digits in each pair of numbers being multiplied?

7. **a.** Use your answer to question 6.d. to predict the following areas.

$16 \text{ m} \times 14 \text{ m} = \underline{\hspace{3cm}} \text{ m}^2$

$85 \text{ m} \times 85 \text{ m} = \underline{\hspace{3cm}} \text{ m}^2$

$48 \text{ m} \times 42 \text{ m} = \underline{\hspace{3cm}} \text{ m}^2$

$95 \text{ m} \times 95 \text{ m} = \underline{\hspace{3cm}} \text{ m}^2$

b. Use your calculator to check your predictions.

8. Make up some more examples that follow your rule, and then use your calculator to check your predictions.

Check your answers on page 108 in the Appendix.

Review

This Review will help you apply what you learned in Module 5 and prepare for the final test. Discuss with your home instructor when you should begin the Review and how much of the Review you should complete.

1. Turn to page 53 of your textbook to On Your Own. Do questions 1 to 5.

If you need help with question 1, look back at Lesson 1, where you learned about conversions among SI units of length. If you feel you need more practice, do question 2.

2. Turn to page 53 of your textbook to Practise Your Skills. Do questions 1 to 12.

Check your answers on pages 108 to 110 in the Appendix.

3. A Canadian silver dollar, “Voyage of Discovery,” was issued in 2000 to commemorate the past and future accomplishments of space flight. One coin has a mass of about 25 g. Copy and complete the following table in your notebook.

Number of Coins	Mass (g)	Mass (kg)	Mass (t)
4			
			0.001
	10 000		
		100	
			1

If you need help with question 3, look back at Lesson 1, where you learned about conversions among SI units of mass. If you feel you need more practice, do question 4.

4. One can of tuna has a mass of 250 g.

- **a.** How many cans have a total mass of 1 kg?
- **b.** How many cans have a total mass of 1 t?
- **c.** Find the mass of 50 cans. Write your answer in grams, kilograms, and tonnes.

Check your answers on page 110 in the Appendix.

5. A pancake recipe that makes 4 servings calls for 125 mL of vegetable oil. Find how much vegetable oil (in millilitres and litres) you would need to make enough pancakes for

- **a.** breakfast for a family of 8
- **b.** brunch for 24 people
- **c.** a community pancake breakfast for 500 people

6. Suppose you made this recipe and used 1 kL of vegetable oil.

   a. How many times would you multiply the recipe?
   b. How many servings of pancakes would you make?

If you need help with questions 5 and 6, look back at Lesson 1, where you learned about conversions among SI units of capacity. If you feel you need more practice, do question 7.

7. One can of orange drink has a capacity of 355 mL.

   a. If you need 1 L of orange drink, how many of these cans will you have to open?

   b. Find the total capacity (in millilitres and litres) of orange drink in a 12-can box.

   c. How many of these cans could be filled with 1 kL of orange drink?

Check your answers on pages 111 and 112 in the Appendix.

8. Turn to page 277 of your textbook to Practise Your Skills. Do questions 1 and 2.

If you need help with question 8, look back at Lesson 2, where you learned about finding the perimeter of polygons. If you feel you need more practice, do question 9.

9. Turn to page 290 of your textbook to Skill Bank from This Unit. Do questions 1 and 2.

Check your answers on pages 112 to 114 in the Appendix.

10. Turn to page 280 of your textbook to Practise Your Skills. Do questions 1 to 8. For questions 1 to 3, use a rule to find the area. For question 4, copy the rectangle and show how you can find the area by counting squares.

If you need help with question 10, look back at Lesson 2, where you learned about finding the area of rectangles. If you feel you need more practice, do question 11.

11. Turn to page 290 of your textbook to Skill Bank from This Unit. Do questions 3 and 4.

Check your answers on pages 114 to 116 in the Appendix.

12. Turn to page 283 of your textbook to Practise Your Skills. Do questions 1 to 12.

If you need help with question 12, look back at Lesson 2, where you learned about the relationship between perimeter and area. If you feel you need more practice, do question 13.

13. Turn to page 290 of your textbook to Skill Bank from This Unit. Do questions 5, 6, and 7.

Check your answers on pages 116 to 119 in the Appendix.

14. Turn to page 237 of your textbook to On Your Own. Do questions 1 to 3.

15. Turn to page 241 of your textbook to On Your Own. Do questions 1 to 5.

16. Turn to page 241 of your textbook to Practise Your Skills. Copy and complete the first four rows of the chart.

If you need help with questions 14 to 16, look back at Lesson 3, where you learned about finding the surface area and volume of rectangular prisms. If you feel you need more practice, do question 17.

17. Turn to page 246 of your textbook to Skill Bank from This Unit. Do questions 4 and 5.

Check your answers on pages 119 to 122 in the Appendix.

18. Rupa compared the volume of a large marble that had a diameter of about 2 cm with the volume of a rubber ball that had a diameter of about 4 cm. She poured some water into a graduated cylinder and read the water level as 110 mL. She put in the rubber ball and the water rose to 142 mL. She then added the marble and the water rose to 146 mL.

- **a.** Use water displacement to find the volume, in cubic centimetres, of the rubber ball and the marble.
- **b.** How many times greater was the volume of the rubber ball than the marble?

If you need help with question 18, look back at Lesson 3, where you learned about finding volume by using water displacement. If you feel you need more practice, do question 19.

19. Two bananas were put in a large graduated cylinder of water. The water level rose from 500 mL to 856 mL. One banana was removed and the water level went down to 642 mL. Find the volume of each banana.

Check your answers on pages 122 and 123 in the Appendix.

20. Turn to pages 288 to 289 of your textbook to Problem Bank.

- **a.** Do question 1 or 2.
- **b.** Do question 3.
- **c.** Do question 4 or 5.
- **d.** Do question 7.
- **e.** Do question 8 or 9.
- **f.** Do question 10.
- **g.** Do question 11 or 12.

21. Turn to pages 244 to 245 of your textbook to Problem Bank. Do questions 3 and 4.

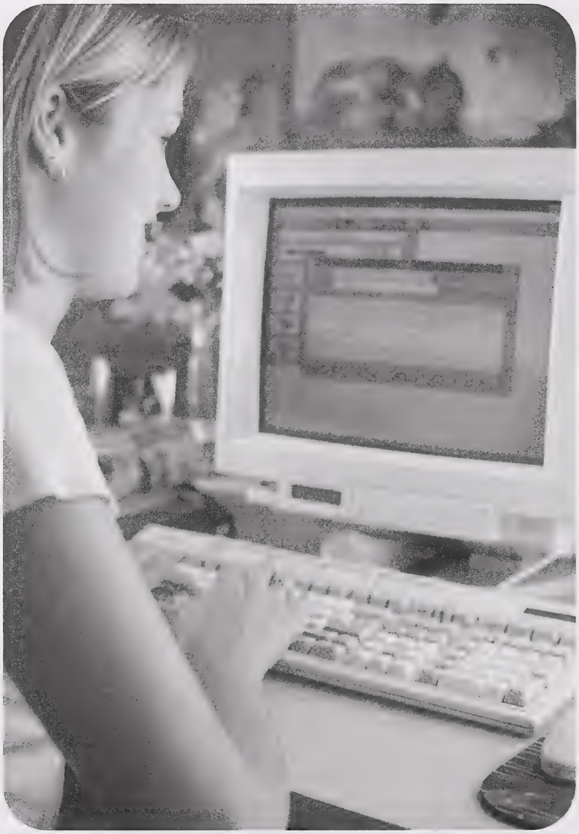
Check your answers on pages 123 to 126 in the Appendix.

If you need additional work to master the material in this module, work through the following lessons on the Mathematics 6 Companion CD:

- Lesson 12: Area and Perimeter
- Lesson 13: Relating Area and Perimeter
- Lesson 14: Surface Area of Prisms
- Lesson 15: Volume and Displacement

After you complete each lesson, you can print out an activity by clicking on the Activity button at the bottom of the screen.

Ask your home instructor to print the solutions to the questions in the activity by clicking on the Parent Notes button at the bottom of the screen. Discuss your answers with your home instructor.



Just the Facts

Ask your home instructor to time you as you complete the following timed drill. Your goal is to complete all 25 questions in two minutes. At the end of two minutes, count how many questions you were able to complete. Then use the Answer Key in the Appendix to mark the drill, and record your score in the space provided. Before you move on, go back and complete any questions you did not finish.

Multiplication and Division Facts

$4 \times 0 =$	$18 \div 3 =$	$\begin{array}{r} 2 \\ \times 2 \\ \hline \end{array}$	$5\overline{)45}$	$6 \times 7 =$
$16 \div 8 =$	$\begin{array}{r} 5 \\ \times 9 \\ \hline \end{array}$	$1\overline{)4}$	$3 \times 4 =$	$24 \div 3 =$
$\begin{array}{r} 6 \\ \times 1 \\ \hline \end{array}$	$5\overline{)40}$	$3 \times 8 =$	$4 \div 4 =$	$\begin{array}{r} 1 \\ \times 5 \\ \hline \end{array}$
$9\overline{)45}$	$7 \times 3 =$	$6 \div 2 =$	$\begin{array}{r} 9 \\ \times 4 \\ \hline \end{array}$	$5\overline{)0}$
$8 \times 5 =$	$49 \div 7 =$	$\begin{array}{r} 1 \\ \times 7 \\ \hline \end{array}$	$6\overline{)18}$	$0 \times 4 =$

Multiplication and Division Facts

Number completed in 2 minutes: ______
Number correct in 2 minutes: ______

Record your score on the Just the Facts Progress Chart.

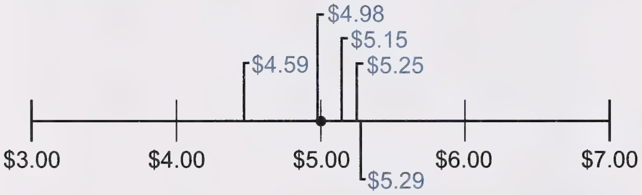
Mental Math

One method you have learned for multiplication is the repeated addition of equal sets. For example, if you need to add $4+4+4+4+4$, think of it as five sets of 4, or $5 \times 4 = 20$. This tip will show you how a strategy called **clustering** can be used to estimate the sum of numbers that are *about* the same size.

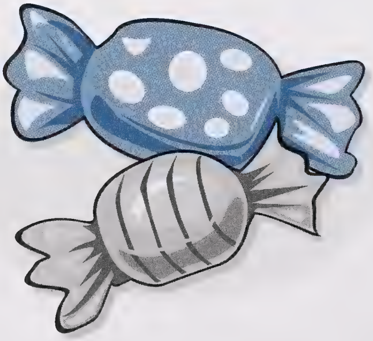
Example 1

Delores is buying 6 bags of bulk candy that cost $4.59, $5.25, $5.15, $4.98, $5.00, and $5.29.

- She thinks of the costs of the bags as around $5.00 each. You can see this by visualizing the costs on a number line.

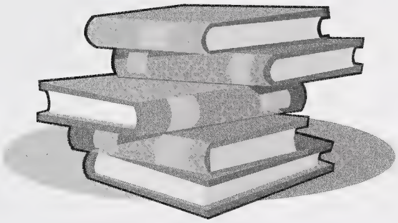


- Since Delores is buying 6 bags, her total cost is about $6 \times \$5 = \$30$.

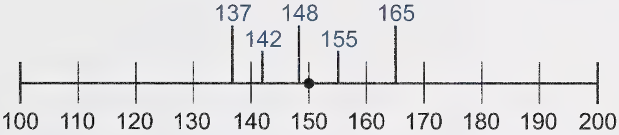


Example 2

Auriana read five books last month for her book club reading marathon. The books had the following number of pages: 142, 155, 137, 165, and 148.



- She thinks of the books as around 150 pages each. You can see this by visualizing the pages on a number line.


137
148
165
142
155
100
110
120
130
140
150
160
170
180
190
200

- Since she read five books, the total number of pages read is $5 \times 150 = 750$.

Try to practise these strategies whenever it is appropriate to use them.

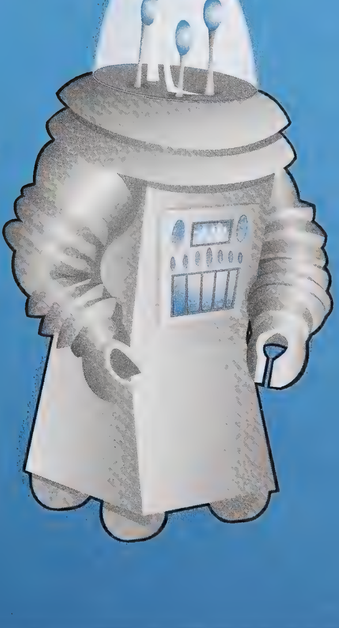
Mathematics 6

Appendix

Glossary

Answer Key

Image Credits



Glossary

area: the number of square units needed to cover a surface

gram: the basic unit of mass in the metric system

hectare: the area of a square that is 100 m on each side

litre: the basic unit of capacity in the metric system; equivalent to $1000\ \text{cm}^3$

metre: the basic unit of length in the metric system

perimeter: the distance around a figure

polygon: a many-sided geometric figure

rectangular prism: a geometric figure shaped like a box with six rectangular faces

surface area of a prism: the sum of the areas of all its faces

tonne: one thousand kilograms

volume: the number of cubic units needed to fill an object completely

water displacement: a technique for finding the volume of an irregularly shaped object

Answer Key

Lesson 1: Metric Measures

Activity 1

1. **a.** The ribbon would be too short by 1 mm = 0.1 cm = 0.01 dm = 0.001 m, but it wouldn't matter because the length of ribbon does not have to be that accurate.

   b. The cloth would be too short by 10 mm = 1 cm = 0.1 dm = 0.01 m, but it wouldn't matter. With 10 m of cloth, you could make several cushions and the length of the cloth does not have to be that accurate.

   c. The string would be too short by 100 mm = 10 cm = 1 dm = 0.1 m, but it wouldn't matter because the length of the string does not have to be that accurate.

2. **a.** There are 1000 m in 1 km. So, the distance would be 1000 mm too short.

   $$1000\ \text{mm} = 100\ \text{cm} = 10\ \text{dm} = 1\ \text{m} = 0.001\ \text{km}$$

   b. There are 1000 m in 1 km. So, in 10 km, the distance would be $10 \times 1000\ \text{mm} = 10\ 000\ \text{mm}$ too short.

   $$10\ 000\ \text{mm} = 1000\ \text{cm} = 100\ \text{dm} = 10\ \text{m} = 0.01\ \text{km}$$

   c. There are 1000 m in 1 km. So, in 100 km, the distance would be $100 \times 1000\ \text{mm} = 100\ 000\ \text{mm}$ too short.

   $$100\ 000\ \text{mm} = 10\ 000\ \text{cm} = 1000\ \text{dm} = 100\ \text{m} = 0.1\ \text{km}$$

3. The calculated distance would be too short by $384\ 321\ \text{km} \div 1000 = 384.321\ \text{km}$.

   $$384.321\ \text{km} = 384\ 321\ \text{m} = 3\ 843\ 210\ \text{dm} = 38\ 432\ 100\ \text{cm} = 384\ 321\ 000\ \text{mm}$$

   The error would matter. The spaceship could miss its destination or crash on the moon.

4. Using this definition of a metre, the distance from the North Pole to the equator is 10 000 000 m, which equals 10 000 km.

5. **a.** Because there are 1000 mm in 1 m, one-millionth of a metre is one-thousandth of a millimetre and is called one micrometre.

   b. If the unit measure was short by one-millionth of a metre $\left(\frac{1}{1\ 000\ 000}\ \text{m}\right)$, the calculated distance would be short by one-millionth of 384 321 km, or 384 321 000 m.

   $$384\ 321\ 000\ \text{m} \div 1\ 000\ 000 = 384.321\ \text{m} = 0.384\ 321\ \text{km}$$

   The error would matter. The spaceship could crash on the moon's surface or it could miss its target on the moon.

6. a. Four-billionths of a metre $= \frac{4}{1\,000\,000\,000}\text{ m} = \frac{1}{250\,000\,000}\text{ m}$

$$= \frac{1}{250\,000\,000}\text{ m} \times 1000\text{ mm/m}$$

$$= \frac{1}{25\,000\,000}\text{ mm}$$

b. If the unit measure was short by four-billionths of a metre, the calculated distance would be short by $384\,321\,000\text{ m} \div 250\,000\,000$, or about 1.5 m. The error likely would matter. The astronauts might have to make precise adjustments to steer their spaceship to the exact target on the moon.

Note: In 1969, during the first-ever manned lunar landing, the U.S. Lunar Excursion Module (LEM) had to be taken off automatic pilot just metres above the surface of the moon and landed manually by the crew of astronauts to avoid a small crater.

7. The unit of measure based on the distance light travels is 40 000 times more accurate than the unit of measure based on orange-red light. Compare four parts per billion to one part per ten trillion.

- four parts per billion = 1 part per 250 000 000
- one part per ten trillion = 1 part per 10 000 000 000 000
- $10\,000\,000\,000\,000 \div 250\,000\,000 = 40\,000$

Activity 2

1. There are a 1000 mg in 1 g. So, multiply the values in the table by 1000. For instance, $0.211 \times 1000 = 211$.

	Vegetable Soup	Tomato Soup	Chicken Noodle Soup
Nutrient	**Number of Milligrams of Nutrient Per 250-mL Serving**		
Potassium	211	227	51
Dietary Fibre	3400	1600	400

2. **a.** Steve ate each kind of soup ten times. There are 30 days in April and he ate each kind every three days.

   b. All of the numbers would be ten times larger in a table that shows the total amount of grams of each nutrient he ate in April.

   c. Steve would have to follow his three-day pattern for 30 days so that the numbers in the table would represent the numbers of decagrams (dag) of each nutrient he ate. Decagrams are 10 times larger than grams and, as you saw in part b., in 30 days he eats 10 times as much.

   d. Steve would have to follow his three-day pattern for 300 days so the numbers in the table would represent the number of hectograms (hg) of each nutrient he ate. In 300 days he would eat each kind $300 \div 3 = 100$ times. $1 \text{ hg} = 100 \text{ g}$, and there would be 100 times as many grams of each nutrient.

   e. Steve would have to follow his three-day pattern for about 3000 days so that the numbers in the table would represent the number of kilograms (kg) of each nutrient he ate, because $1 \text{ kg} = 1000 \text{ g}$, and there would be 1000 times as many grams of each nutrient. $(3000 \text{ days} \div 365 \text{ days per year} \doteq 9 \text{ years})$.

3. A 280-g bag of cheese snacks contains ten 28-g servings.

   $10 \times 28\text{g} = 280\text{g}$

   Multiply each number in the single-serving table by 10. For example, $1.7 \text{ g} \times 10 = 17 \text{ g}$.

Nutrient	Grams Per 280-g Bag
Protein	17 g
Fat	120 g
Carbohydrates	130 g
Dietary Fibre	4 g
Sodium	$4.4 \text{ g} = 4400 \text{ mg}$
Potassium	$0.79 \text{ g} = 790 \text{ mg}$

4. You would have to eat about thirteen 28-g servings to get 1 g of potassium.

- 79 mg is almost 80 mg and $1\ \text{g} = 1000\ \text{mg}$.
- $1000\ \text{mg} \div 80\ \text{mg} = 100\ \text{mg} \div 8\ \text{mg}$
- To divide 100 by 8, divide 100 in half three times (because $8 = 2 \times 2 \times 2$).

$100 \div 2 = 50;\ 50 \div 2 = 25;\ 25 \div 2 = 12.5$ (which is about 13)

5. You would have to eat about eight 280-g bags to get 1 kg of fat.

$8 \times 120\ \text{g} = 960\ \text{g}$, which is almost 1000 g or 1 kg

6. **a.** You can prove that each box makes servings by dividing.

There are $8.2\ \text{g} + 9.6\ \text{g} + 39\ \text{g} = 56.8\ \text{g}$ per serving.

$224\text{-g box} \div 56.8\text{-g serving} \doteq 4$ servings

b.

Nutrient	Grams Per Whole Box of Dry Ingredients	Grams Per Whole Box of Prepared Macaroni and Cheese
Protein	30.8	32.8
Fat	8.4	38.4
Carbohydrates	152	156

7. **a.** One gram of fat comes from just the milk.

Fifty millilitres is one-fifth of 250 mL, and one-fifth of 5 g of fat is 1 g of fat.

b. Twenty-nine grams of fat come from just the butter.

- There are $38.4\ \text{g} - 8.4\ \text{g} = 30\ \text{g}$ more fat in the prepared macaroni and cheese than in just the dry ingredients. Therefore, there is a total of 30 g of fat from the butter and milk being added.

- In question 7.a., you found that 1 g of fat comes from the milk. Therefore, $30\ \text{g} - 1\ \text{g} = 29\ \text{g}$ of fat must come from the butter.

8. a. About 30 boxes of prepared macaroni and cheese would have about 1 kg of protein.

- 32.8 g is about 33 g, and $3\ \text{boxes} \times 33\ \text{g} = 99\ \text{g}$, which is about 100 g in three boxes.

- You want ten times the above amount because $1\ \text{kg} = 1000\ \text{g} = 10 \times 100\ \text{g}$.

- If three boxes have about 100 g, then $10 \times 3 = 30$ boxes have about $1000\ \text{g} = 1\ \text{kg}$.

b. About 25 boxes of prepared macaroni and cheese would have about 1 kg of fat.

38.4 g is about 40 g of fat per box, and $1000\ \text{g} \div 40\ \text{g} = 100 \div 4 = 25$ boxes.

c. About six or seven boxes of prepared macaroni and cheese would have about 1 kg of carbohydrates.

156 g is about 150 g, and $6\ \text{boxes} \times 150\ \text{g} = 900\ \text{g}$; $7\ \text{boxes} \times 150\ \text{g} = 1050\ \text{g}$

9. It is not likely that Tom ate 1 t of ravioli last year. Each can has a mass of 425 g, which is a little less than 0.5 kg. If Tom eats one can per day, then he eats about 1 kg every two days. Even if there were 400 days in a year, $400\ \text{days} \div 2 = 200\ \text{kg}$ per year. So, Tom eats less than 200 kg a year, and $1\ \text{t} = 1000\ \text{kg}$. It would take Tom more than five years to eat 1 t of ravioli because $1000\ \text{kg} \div 200\ \text{kg per year} = 5$ years.

10. Eeny bought the most popcorn.

Write the amount each person bought in grams.

- Eeny bought $0.5\ \text{kg} = 500\ \text{g}$.
- Meeny bought $35\ \text{dag} = 350\ \text{g}$.
- Miny bought $4\ \text{hg} = 400\ \text{g}$.
- Mo bought 300 g of popcorn.

11. a. The farmer could sell 900 kg of potatoes for every 1 t that he harvested.

- He can't sell 10%, which is one-tenth of the potatoes.
- $1\ \text{t} = 1000\ \text{kg}$, and $1000\ \text{kg} \div 10 = 100\ \text{kg}$ of spoiled potatoes per 1 t harvested.
- He can sell $1000\ \text{kg} - 100\ \text{kg} = 900\ \text{kg}$ of potatoes per 1 t harvested.

b. The farmer can package ninety 10-kg bags for sale from each tonne of potatoes harvested.

$$900\ \text{kg} \div 10\ \text{kg} = 90$$

Activity 3

1. a. The following table shows all six ways Ms. Brown could buy exactly 1.5 L of 2% milk and the cost of each way.

1 L	500 mL	250 mL	Cost
1	1		$\$1.17 + \$0.88 = \$2.05$
1		2	$\$1.17 + (2 \times \$0.53) = \$2.23$
	3		$3 \times \$0.88 = \$2.64$
	2	2	$(2 \times \$0.88) + (2 \times \$0.53) = \$2.82$
	1	4	$\$0.88 + (4 \times \$0.53) = \$3.00$
		6	$6 \times \$0.53 = \$3.18$

b. The most economical way is to buy a 1-L carton and a 250-mL carton. The larger the size of the carton, the better the buy.

c. The least economical way is to buy six 250-mL cartons.

2. - The most economical way he can buy 1.25 L of 1% milk is to buy one 1-L carton and one 250-mL carton.

  $$\$1.15 + \$0.52 = \$1.67$$

- The most economical way he can buy 2.75 L of 2% milk is to buy one 2-L carton, one 500-mL carton, and one 250-mL carton.

  $$\$2.25 + \$0.88 + \$0.53 = \$3.66$$

- The most economical way he can buy 1.5 L of homo milk is to buy one 1-L carton and one 500-mL carton.

  $$\$1.19 + \$0.90 = \$2.09$$

3. The most economical way Miss Grey can do this is to buy one 2-L carton of 2% milk for $2.25 (although she would have 250 mL of milk left over). If she were to buy exactly 1.75 L of 2% milk most economically, she would spend $2.58, which is 33¢ more.

$$\begin{aligned}&(1\times 1\text{-L carton}) + (1\times 500\text{-mL carton}) + (1\times 250\text{-mL carton})\\&= \$1.17 + \$0.88 + \$0.53\\&= \$2.58\end{aligned}$$

4. You should agree with Mrs. Reed because instead of buying the 250-mL size continually, she could have been buying the 4-L size.

- $1\ \text{L} = 4 \times 250\ \text{mL}$, so $4\ \text{L} = 16 \times 250\ \text{mL}$
- A 4-L carton of 1% milk costs $4.29, and $\$4.29 \div 16$ is about $0.27 for 250 mL.
- She has been paying $0.52 per 250 mL, which is almost double.

5. Shannon's dad needed 854 mL more gasoline this time than the previous time.

$$44.384\ \text{L} - 43.53\ \text{L} = 0.854\ \text{L} = 854\ \text{mL}$$

6. If Greg uses about a tank of gas every two weeks, he will use 1.3 kL of gas in a year.

- $1 \text{ year} = 52 \text{ weeks}$
- $52 \text{ weeks} \div 2 \text{ weeks} = 26 \text{ tanks}$
- $26 \text{ tanks} \times 50 \text{ L} = 1300 \text{ L} = 1.3 \text{ kL}$

7. a. Janice's family used 48.3 kL of water in July.

- $7638.3 \text{ m}^3 - 7590.0 \text{ m}^3 = 48.3 \text{ m}^3$
- $1 \text{ m}^3 = 1 \text{ kL}$, so $48.3 \text{ m}^3 = 48.3 \text{ kL}$

b. Janice's family used about 1600 L of water each day.

- 48.3 kL is about $48 \text{ kL} = 48\,000 \text{ L}$
- 1 month is about 30 days.
- $48\,000 \div 30 = 4800 \div 3 = 1600 \text{ L/day}$

8. a. The volume of the dirt removed is $11\,000 \text{ dm}^3 = 11 \text{ m}^3$.

- $2000 \times 5.5 \text{ dm}^3 = 11\,000 \text{ dm}^3$
- $1 \text{ m}^3 = 1000 \text{ dm}^3$, so $= 11\,000 \text{ dm}^3 \div 1000 = 11 \text{ m}^3$

b. The capacity of the pond is $11\,000 \text{ L} = 11 \text{ kL}$.

- $1 \text{ dm}^3 = 1 \text{ L}$, so $11\,000 \text{ dm}^3 = 11\,000 \text{ L}$
- $1 \text{ m}^3 = 1 \text{ kL}$, so $11 \text{ m}^3 = 11 \text{ kL}$

9. a. $200 \text{ mL} = 2 \text{ dL}$
b. $500 \text{ mL} = 5 \text{ dL}$
c. $350 \text{ mL} = 3.5 \text{ dL}$

10. It is not correct to write units of capacity with a raised 3, such as L^3 or mL^3, because a litre is already 1000 cm^3.

Challenge Activity

Answers will vary. Sample answers are given.

1. The following solution takes seven steps.

Step	Description	Water in Each Pail (L)		
		8-L Pail	5-L Pail	3-L Pail
0	Start with the 8-L pail full. (The others are empty.)	8	0	0
1	Fill the 3-L pail from the 8-L pail.	5	0	3
2	Empty the 3-L pail into the 5-L pail.	5	3	0
3	Fill the 3-L pail from the 8-L pail.	2	3	3
4	Fill the 5-L pail from the 3-L pail.	2	5	1
5	Empty the 5-L pail into the 8-L pail.	7	0	1
6	Empty the 3-L pail into the 5-L pail.	7	1	0
7	Fill the 3-L pail from the 8-L pail, leaving 4 L.	4	1	3

2. Johan can measure exactly 4 L of water in only six steps.

Step	Description	Water in Each Pail (L)		
		8-L Pail	5-L Pail	3-L Pail
0	Start with the 8-L pail full. (The others are empty.)	8	0	0
1	Fill the 5-L pail from the 8-L pail.	3	5	0
2	Fill the 3-L pail from the 5-L pail.	3	2	3
3	Empty the 3-L pail into the 8-L pail.	6	2	0
4	Empty the 5-L pail into the 3-L pail.	6	0	2
5	Fill the 5-L pail from the 8-L pail.	1	5	2
6	Fill the 3-L pail from the 5-L pail, leaving 4 L.	1	4	3

Lesson 2: Perimeter and Area

Activity 1

	Name of Polygon	Method 1 to Find Perimeter (Addition)	Method 2 to Find Perimeter
1.	Kite	$16+16+10+10=52\text{ cm}$	$(2\times16)+(2\times10)$ $=32+20$ $=52\text{ cm}$
2.	Regular Hexagon	$8+8+8+8+8+8=48\text{ cm}$	$6\times8=48\text{ cm}$
3.	Isosceles Triangle	$16+16+13=45\text{ cm}$	$(2\times16)+13$ $=32+13$ $=45\text{ cm}$
4.	Rhombus	$12+12+12+12=48\text{ cm}$	$4\times12=48\text{ cm}$
5.	Regular Pentagon	$9+9+9+9+9=45\text{ cm}$	$5\times9=45\text{ cm}$
6.	Regular Octagon	$5+5+5+5+5+5+5+5=40\text{ cm}$	$8\times5=40\text{ cm}$
7.	Octagon	$4+5+4+11+4+5+4+11=48\text{ cm}$	$(4\times4)+(2\times5)+(2\times11)$ $=16+10+22$ $=48\text{ cm}$
8.	Regular Heptagon	$6+6+6+6+6+6+6=42\text{ cm}$	$7\times6=42\text{ cm}$
9.	Regular Decagon	$4+4+4+4+4+4+4+4+4+4=40\text{ cm}$	$10\times4=40\text{ cm}$

10. To find the perimeter of any figure, just add the lengths of all of its sides together.

11. It is possible to find the perimeter with one multiplication step for any polygon that has all of its sides the same length, as in questions 2, 4, 5, 6, 8, and 9. This works because multiplication is a quick way to add the same number over and over.

12. a. Evan needed the least length of framing material for the regular octagon and the regular decagon.

b. Evan needed the greatest length of framing material for the kite.

c. Evan needs a total of 408 cm = 4.08 m of framing material for the nine patches.

$$\begin{aligned}\text{Total} &= (52+48)+48+(45+45)+(48+42)+(40+40)\\ &= 100+90+90+80+48\\ &= 90+10+80+90+90+48\\ &= (4\times 90)+48\\ &= 360+48\\ &= 408 \text{ cm}\\ &= 4.08 \text{ m}\end{aligned}$$

13. Answers will vary. Sample answers are given.

- It would take Evan the greatest amount of time to make the frame for the regular decagon because it has the most sides and it would need the most cutting and gluing.
- It would take Evan the greatest amount of time to make the frame for the octagon because it has a lot of sides of different lengths to cut and glue together.

Activity 2

1. Matthew can be sure that the 1985 locomotive stamp is not the largest just by comparing its dimensions with the other stamps. Both the length and the width of the locomotive stamp are shorter than the length and width of the 1992 industrial design stamp. This means, in fact, that the locomotive stamp would fit inside the industrial design stamp.

2. **a.** There are 1380 squares in the array.

$$23 \text{ rows} \times 60 \text{ squares per row} = 1380 \text{ squares}$$

b. The area of each square in the array is 1 mm^2.

c. The area of the Constitution stamp is 1380 mm^2.

There are 23 rows with 60 mm^2 in each row, and $23\times 60 \text{ mm}^2 = 1380 \text{ mm}^2$.

3. **a.** The area of the 1983 Commonwealth Day stamp is $40\ \text{mm} \times 48\ \text{mm} = 1920\ \text{mm}^2$.
   b. The area of the 1985 locomotive stamp is $25\ \text{mm} \times 55\ \text{mm} = 1375\ \text{mm}^2$.
   c. The area of the 1992 industrial design stamp is $34\ \text{mm} \times 60\ \text{mm} = 2040\ \text{mm}^2$.
   d. The area of the 1997 grizzly bear stamp is $49\ \text{mm} \times 64\ \text{mm} = 3136\ \text{mm}^2$.

4. **a.** Matthew's 1992 industrial design stamp has the largest area.

   b. The grizzly bear stamp is $1096\ \text{mm}^2$ larger than Matthew's largest stamp.

   $$3136\ \text{mm}^2 - 2040\ \text{mm}^2 = 1096\ \text{mm}^2$$

   c. The 1988 Winter Games stamp is half the area of the grizzly bear stamp. Therefore, the grizzly bear stamp is $1568\ \text{mm}^2$ (the area of the Winter Games stamp itself) larger than it.

   $$2 \times 1568\ \text{mm}^2 = 3136\ \text{mm}^2\text{, and } 1568\ \text{mm} + 1568\ \text{mm} = 3136\ \text{mm}^2$$

   OR

   $$3136\ \text{mm}^2 \div 2 = 1568\ \text{mm}^2\text{, and } 3136\ \text{mm}^2 - 1568\ \text{mm} = 1568\ \text{mm}$$

5. **a.** To find the area of each bulletin board, Perry can multiply its length and width.

   b. The bulletin board with the greatest surface area is 40 cm by 75 cm.

   - $45\ \text{cm} \times 60\ \text{cm} = 2700\ \text{cm}^2$
   - $50\ \text{cm} \times 55\ \text{cm} = 2750\ \text{cm}^2$
   - $40\ \text{cm} \times 75\ \text{cm} = 3000\ \text{cm}^2$
   - $35\ \text{cm} \times 65\ \text{cm} = 2275\ \text{cm}^2$

6. **a.** Each square in the picture represents $1\ \text{m}^2$.
   b. There are 20 whole squares in the picture.
   c. Each rectangle in the bottom row is 0.5, or $\frac{1}{2}$, of a whole square.
   d. The area of Drina's room is $22.5\ \text{m}^2$.

   - Count the rows of squares first: 5, 10, 15, 20.
   - Count on by 1 for every pair of rectangles in the bottom row: 21, 22.
   - There is an odd number of rectangles, so add half for the last one.

e. Multiply its length and width.

$4.5\ \text{m} \times 5\ \text{m} = 22.5\ \text{m}^2$

7. a. The areas of the three rugs are $4\ \text{m} \times 4.8\ \text{m} = 19.2\ \text{m}^2$, $4\ \text{m} \times 5\ \text{m} = 20\ \text{m}^2$, and $3\ \text{m} \times 5.4\ \text{m} = 16.2\ \text{m}^2$.

b. Drina can't use all of them, even though the area of each of the three rugs is less than the area of her room. She can use the $4\ \text{m} \times 4.8\ \text{m}$ rug and the $4\ \text{m} \times 5\ \text{m}$ rug, but she can't use the 3 m by 5.4 m rug. It is too long to fit in her room.

8. a. The areas of the lots are $3\ \text{hm} \times 3.5\ \text{hm} = 10.5\ \text{hm}^2 = 10.5\ \text{ha}$, $3\ \text{hm} \times 5.3\ \text{hm} = 15.9\ \text{hm}^2 = 15.9\ \text{ha}$, and $1\ \text{hm} \times 10\ \text{hm} = 10\ \text{ha}$.

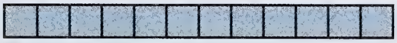
b. The $3\ \text{hm} \times 3.5\ \text{hm}$ lot best suits the needs for the park. The $3\ \text{hm} \times 5.3\ \text{hm}$ lot is too large, and the $1\ \text{hm} \times 10\ \text{hm}$ lot is too long and narrow.

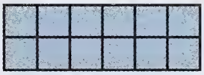
9. The newspaper report that almost 60 ha of forest were destroyed by the fire is incorrect.

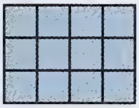
$6\ \text{km} \times 6\ \text{km} = 36\ \text{km}^2$, which is close to $35\ \text{km}^2$. 64 ha is much too small. Because $1\ \text{ha} = 100\ \text{m} \times 100\ \text{m}$, $64\ \text{ha}$ is only $800\ \text{m} \times 800\ \text{m}$.

Activity 3

1. Leslie and Lambert can make the following three large rectangular tables.
Note: Rotations of the three rectangles are not considered to be different solutions.

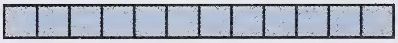




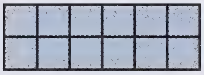


2. **a.** The more compact the table, the less border it requires. The 3-by-4 table will require the least amount of border. The 12-by-1 table will require the most.

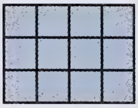
   b. If the small tables have sides of 1 m, count the number of 1-m table edges that make up the four edges of each large table.



12 m + 1 m + 12 m + 1 m = 26 m



6 m + 2 m + 6 m + 2 m = 16 m



4 m + 3 m + 4 m + 3 m = 14 m

3. **a.** All the large tables have the same area of 12 m^2, but they have different perimeters.

   b. The perimeter of the large table gets shorter as its shape gets closer to being a square.

4. Answers will vary. Sample answers are given.

   a. They may use the tables for seating people or for buffet tables to hold the food.

   b. Useful table arrangements will depend on the number of small tables available, the number of people attending, the size of the hall, and the ways the tables need to be used. For example,

   - If everyone must be seated to eat, the longest arrangement allows for the most number of people to be seated, but the other two arrangements better allow for people to talk to each other.

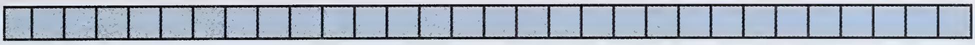
   - The longest arrangement might be useful to set out food for a buffet.

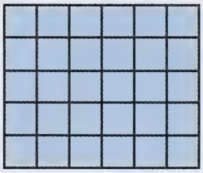
5. **a.** The dimensions of the large tables are 1 m × 12 m, 2 m × 6 m, and 3 m × 4 m.

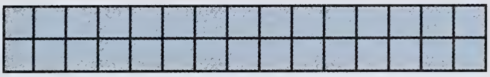
   b. The product of each of these pairs of numbers is 12. All of these numbers are called factors of 12.

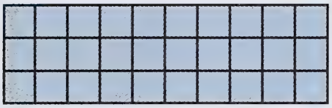
6. **a.** Select 30 tiles and make as many rectangular arrangements with them as possible.

b. The following rectangular arrangements can be made.


1 × 30

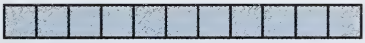

5 × 6

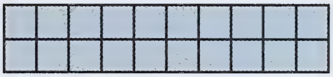

2 × 15

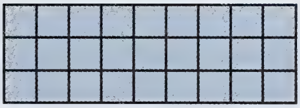

3 × 10

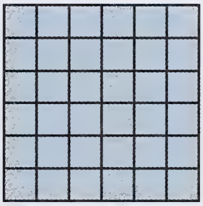
c. The factors of 30 are 1, 2, 3, 5, 6, 10, 15, and 30.

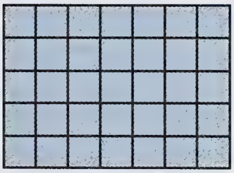
7. a. They could make a large rectangular table with a perimeter of 24 m in the following ways.

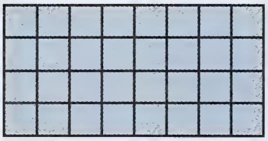

1 × 11


2 × 10


3 × 9


6 × 6


5 × 7


4 × 8

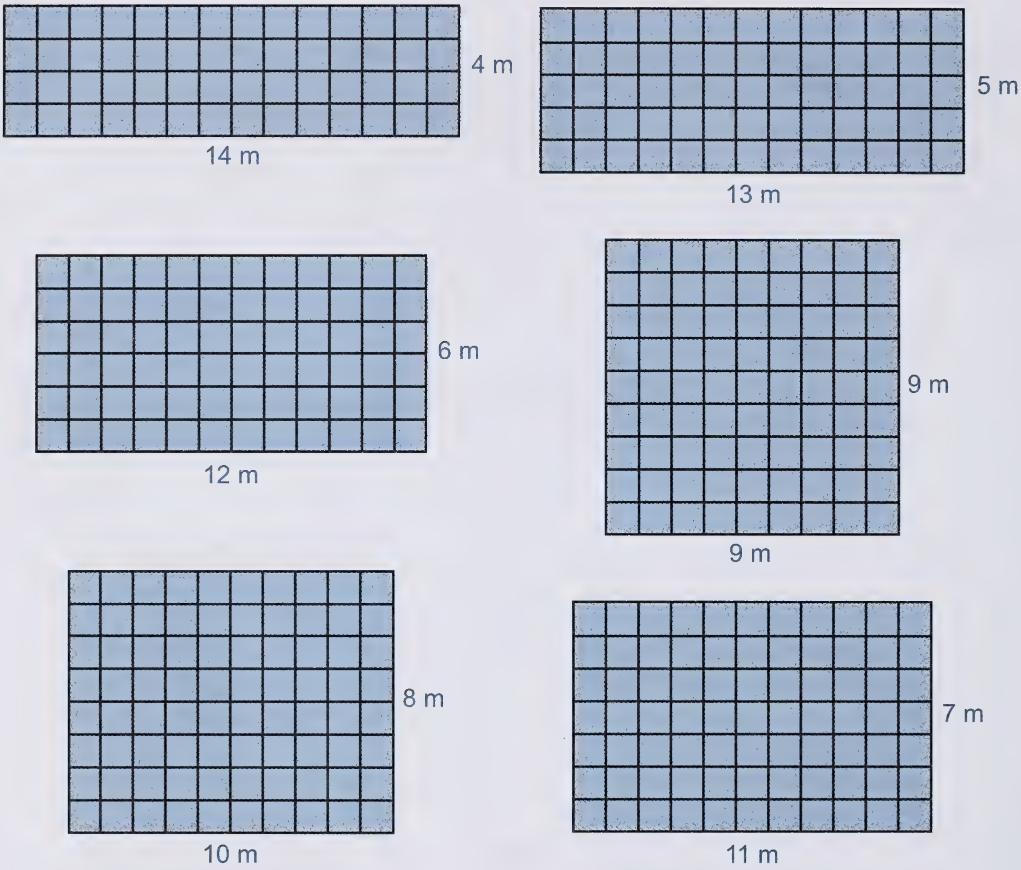
b. The least number of tables they could use is 11. The greatest number of tables they could use is 36.

c. As the area of the table gets larger, it gets closer to being a square.

8. Fold the entire length of the border in half and then in half again to form four equal parts. Then unfold it and use the four equal parts as sides of a square.

Challenge Activity

1. The six possible rectangles are shown in the following picture.



The strategy is to pick two numbers that add together to make 18 (half of the perimeter).

2. Answers may vary. A sample answer is given.

A 3.5 m by 14.5 m rectangle has a perimeter of 36 m, and an area close to 50 m^2.

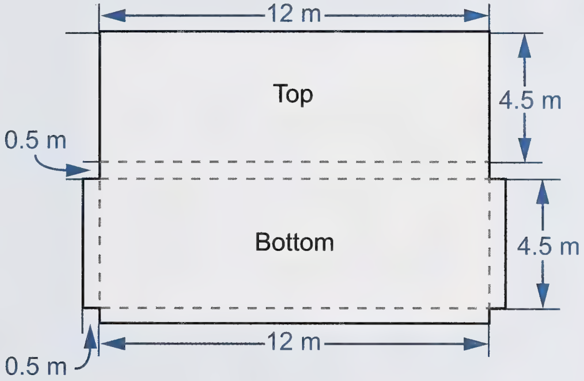
Lesson 3: Surface Area and Volume

Activity 1

1. **a.** The SABB has six faces. All of them are rectangular in shape.

   b. Two of the faces have dimensions that measure 4.5 m by 12 m, another two faces measure 4.5 m by 0.5 m, and another two faces measure 12 m by 0.5 m.

2. Your net should be similar to the one shown.



3. The SABB might have a surface area of a little more than $100\ \text{m}^2$. Each large rectangle has an area of about $50\ \text{m}^2$, and there are two of them. The four small rectangular strips will add several square metres to the total surface area.

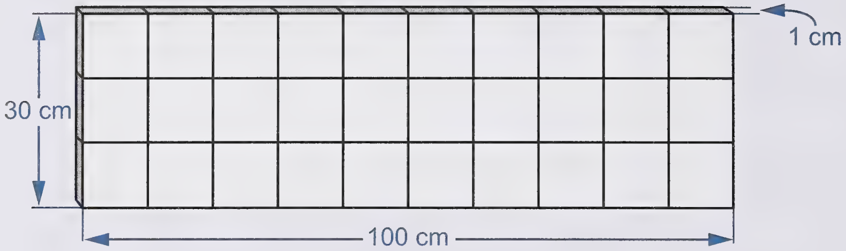
4. **a.** The areas of the faces of the SABB are

   - two faces, each $12\ \text{m} \times 4.5\ \text{m} = 54\ \text{m}^2$
   - two faces, each $12\ \text{m} \times 0.5\ \text{m} = 6\ \text{m}^2$
   - two faces, each $4.5\ \text{m} \times 0.5\ \text{m} = 2.25\ \text{m}^2$

   b. The surface area of the SABB is $124.5\ \text{m}^2$.

   - $2 \times 54\ \text{m}^2 = 108\ \text{m}^2$
     $2 \times 6\ \text{m}^2 = 12\ \text{m}^2$
     $2 \times 2.25\ \text{m}^2 = 4.5\ \text{m}^2$
   - $108\ \text{m}^2 + 12\ \text{m}^2 + 4.5\ \text{m}^2 = 124.5\ \text{m}^2$

5.



6. The surface area of the base ten model of the unfolded solar panel is $6260\ \text{cm}^2$.

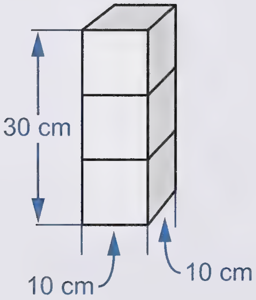
- two faces, each $100\ \text{cm} \times 30\ \text{cm} = 3000\ \text{cm}^2$
  $2 \times 3000\ \text{cm}^2 = 6000\ \text{cm}^2$

- two faces, each $100\ \text{cm} \times 1\ \text{cm} = 100\ \text{cm}^2$
  $2\ \text{cm} \times 100\ \text{cm}^2 = 200\ \text{cm}^2$

- two faces, each $30\ \text{cm} \times 1\ \text{cm} = 30\ \text{cm}^2$
  $2\ \times 30\ \text{cm}^2 = 60\ \text{cm}^2$

- The total surface area is $6000\ \text{cm}^2 + 200\ \text{cm}^2 + 60\ \text{cm}^2 = 6260\ \text{cm}^2$.

7. A base ten model of the completely folded solar panel measures 10 cm by 10 cm by 30 cm.



8. The surface area of the base ten model of the completely folded solar panel is $1400\ \text{cm}^2$.

- four faces, each $30\ \text{cm} \times 10\ \text{cm} = 300\ \text{cm}^2$
  $4\ \text{cm} \times 300\ \text{cm}^2 = 1200\ \text{cm}^2$

- two faces, each $10\ \text{cm} \times 10\ \text{cm} = 100\ \text{cm}^2$
  $2 \times 100\ \text{cm} = 200\ \text{cm}^2$

- The total surface area is $1200\ \text{cm}^2 + 200\ \text{cm} = 1400\ \text{cm}^2$.

9. **a.** The surface area of the SABB is about $108\ \text{m}^2$.

- $2 \times (10\ \text{m} \times 1\ \text{m}) = 20\ \text{m}^2$
  $2 \times (10\ \text{m} \times 4\ \text{m}) = 80\ \text{m}^2$
  $2 \times (4\ \text{m} \times 1\ \text{m}) = 8\ \text{m}^2$

- $20\ \text{m}^2 + 80\ \text{m}^2 + 8\ \text{m}^2 = 108\ \text{m}^2$

b. The surface area of the SABB is $113.2\ \text{m}^2$.

- two faces, each $10 \times 0.8\ \text{m} = 8\ \text{m}^2$
  $2 \times 8\ \text{m} = 16\ \text{m}^2$

- two faces, each $10\ \text{m} \times 4.5\ \text{m} = 45\ \text{m}^2$
  $2 \times 45\ \text{m}^2 = 90\ \text{m}^2$

- two faces, each $4.5 \times 0.8\ \text{m} = 3.6\ \text{m}^2$
  $2 \times 3.6\ \text{m}^2 = 7.2\ \text{m}^2$

- The total surface area is $16\ \text{m}^2 + 90\ \text{m}^2 + 7.2\ \text{m}^2 = 113.2\ \text{m}^2$.

10. a. When the panel is unfolded, its dimensions are 10 m by 36 m by 0.1 m. It stays the same width (10 m), but it becomes 8 times longer $(8 \times 4.5 \text{ m} = 36 \text{ m})$ and $\frac{1}{8}$ as thick $(0.8 \div 8 = 0.1 \text{ m})$.

b. The area of its largest face is 360 m^2 $(10 \text{ m} \times 36 \text{ m})$.

Activity 2

1. The surface areas of all three rectangular prisms are equal. Each of the three prisms are made from a single sheet of paper that is the same size. Each prism uses the whole sheet. No paper is wasted.

2. The more compact (more like a cube) the prisms are, the greater the volume, so the volumes will be in the following order from largest to smallest: Sara's > Rob's > Izak's.

3. The volume of Rob's prism is 882 cm^3. Each layer has $7 \times 7 = 49$ centicubes, so 18 layers have $18 \times 49 = 882$ centicubes. Each centicube is 1 cm^3.

4. You should agree with Rob.

- The number of rows of centicubes is the width of the base of his prism.
- The number of centicubes in each row is the length of the base of his prism.
- The number of layers he can make is the height of his prism.

5. a. The volume of Izak's prism is about 750 cm^3. Since the base is greater than a 5-by-5 array and less than a 6-by-6 array, you could estimate it to be about the size of a 5-by-6 array, which is 30 cm^2. He could make 25 layers, so multiply.

$$25 \text{ cm} \times 30 \text{ cm}^2 = 750 \text{ cm}^3$$

b. $5.4 \text{ cm} \times 5.4 \text{ cm} \times 25.3 \text{ cm}$ is about 738 cm^3.

6. a. Your answer will depend on your prediction in question 2.

b. The volume of Sara's prism will be the greatest of the three. Her prism is very compact. It is closest to being a cube.

7. **a.** The sides of the square bases are 10.8 cm.
   b. The height is 8.6 cm.

8. **a.** The volume of Sara's prism is about $1000\ \text{cm}^3$, which equals 1 L. Two dimensions are greater than 10 and one dimension is less than 10, so if you use 10 cm for all three dimensions, $10\ \text{cm} \times 10\ \text{cm} \times 10\ \text{cm} = 1000\ \text{cm}^3$.

   b. $10.8\ \text{cm} \times 10.8\ \text{cm} \times 8.6\ \text{cm}$ is about $1003\ \text{cm}^3$.

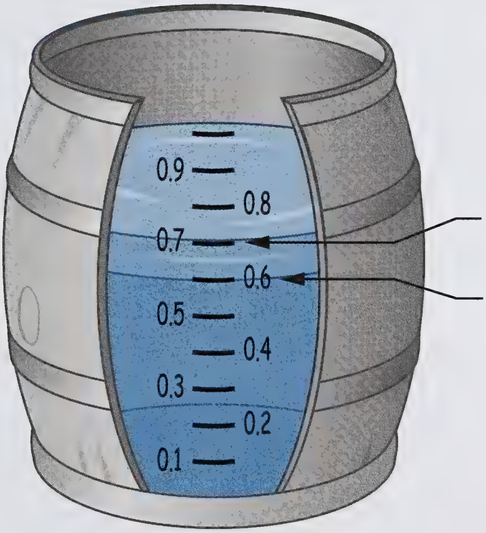
   c. The prediction in question 6.b. was correct. Sara's prism has the greatest volume.

9. **a.** If prisms have the same surface area, the closer a prism is to being a cube, the greater volume it will have.

   b. To package a given volume of soap, you would use the least amount of cardboard by making the box in the shape of a cube. However, manufacturers usually build their boxes with large front panels to get customers to see it better on store shelves (a form of advertisement).

Activity 3

1. **a.**



0.7 m³ Water level after pumpkin was submerged

0.6 m³ Water level before pumpkin was submerged

b. The volume of Phil's pumpkin is $0.1\ \text{m}^3$ and its capacity is 100 L. The volume of the pumpkin is the same as the water that was displaced by it, so subtract the water level before the pumpkin was submerged from the water level after the pumpkin was submerged.

$$0.7\ \text{m}^3 - 0.6\ \text{m}^3 = 0.1\ \text{m}^3 = 100\ \text{L}$$

2. a. The volume of Don's pumpkin is $0.11\ \text{m}^3 = 110\ \text{dm}^3 = 110\ 000\ \text{cm}^3$, and its capacity is $110\ \text{L} = 110\ 000\ \text{mL}$. Subtract the water level before Don's pumpkin was submerged from the water level after it was submerged.

$$0.81\ \text{m}^3 - 0.7\ \text{m}^3 = 0.11\ \text{m}^3$$

$$0.11\ \text{m}^3 = 110\ \text{L} = 110\ 000\ \text{mL}$$

b. Don's pumpkin has the greater volume by $0.01\ \text{m}^3$ $\left(0.11\ \text{m}^3 - 0.1\ \text{m}^3\right)$ and therefore, a greater capacity by 10 L $\left(110\ \text{L} - 100\ \text{L}\right)$ because it displaced more water than Phil's pumpkin.

c. Don may think that he deserved the prize for having the largest pumpkin because his had the largest capacity. To be fair, the judge might settle the contest by giving two prizes: one to Phil for having the heaviest pumpkin and one to Don for having the pumpkin with the largest volume or capacity.

3. a. The capacity of the third pumpkin is 70 000 mL because $1\ \text{L} = 1000\ \text{mL}$.

b. Remember, $1\ \text{mL} = 1\ \text{cm}^3$, so the volume of the third pumpkin is $70\ 000\ \text{cm}^3 = 70\ \text{dm}^3 = 0.07\ \text{m}^3$.

c. The water rose to the new level of $0.88\ \text{m}^3$.

- $70\ \text{L} = 70\ \text{dm}^3 = 0.07\ \text{m}^3$ (Move the decimal three places left because it takes $1000\ \text{dm}^3$ to make $1\ \text{m}^3$. $1\ \text{dm}^3 = 1$ L and $1\ \text{m}^3 = 1000\ \text{L}$)
- The new level becomes $0.81\ \text{m}^3 + 0.07\ \text{m}^3 = 0.88\ \text{m}^3$.

4. **a.** The volume of the removed pumpkin is $0.09\ \text{m}^3 = 90\ \text{dm}^3 = 90\ 000\ \text{cm}^3$.

$$0.94\ \text{m}^3 - 0.85\ \text{m}^3 = 0.09\ \text{m}^3 = 90\ \text{dm}^3 = 90\ 000\ \text{cm}^3$$

   b. The capacity of the removed pumpkin is $90\ \text{L} = 90\ 000\ \text{mL}$.

$$90\ \text{dm}^3 = 90\ \text{L} = 90\ 000\ \text{mL}$$

5. To use water displacement to measure 200 mL of butter, Ms. Peters can do the following:

   - Put cold water (so as not to melt the butter) exactly up to the 300-mL level of the measuring cup.
   - Put scoops of butter in the water until the water rises to the 500-mL level.
   - Carefully pour out the water and use the butter in her pie recipe.

6. Velda cannot use water displacement because the sugar will dissolve in the water without changing the level of the water.

7. To decide how many small eggs to use for one pie, he must find how many small eggs have the same volume as three large eggs. Mr. Simon can do the following:

   - Put three large eggs in a measuring container.
   - Put in water to cover the eggs and note the water level.
   - Remove the large eggs, and put in small eggs until the water reaches as close as possible to the same level as it did with the three large eggs.

8. You may disagree with Jim because he was not completely submerged in the water. The amount of water displaced was only equal to the amount of his body that was submerged.

Challenge Activity

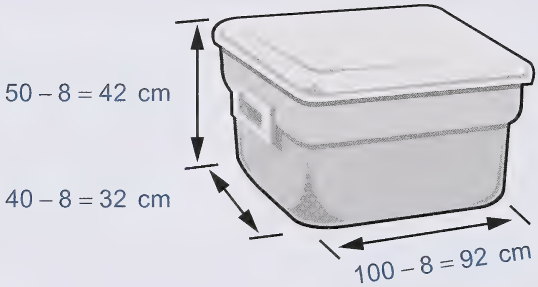
1. The cooler occupies a volume of $200\ 000\ \text{cm}^3 = 200\ \text{dm}^3 = 0.2\ \text{m}^3$.

- Multiply the three centimetre dimensions.
  Remember, $1\ \text{m} = 100\ \text{cm}$.

  $$100\ \text{cm} \times 40\ \text{cm} \times 50\ \text{cm} = 200\ 000\ \text{cm}^3$$

- Convert to the larger units of volume by moving the decimal three places to the left each time.

2. The capacity of the cooler is 123.648 L. If each face is 4 cm thick, each of the inside dimensions of the cooler is 8 cm less than the outside dimensions.



The inside volume is $92\ \text{cm} \times 32\ \text{cm} \times 42\ \text{cm} = 123\ 648\ \text{cm}^3$. This means that the capacity is $123\ 648\ \text{mL} = 123.648\ \text{L}$.

3. The total volume of the foam used to make the cooler is $76\ 352\ \text{cm}^3 = 76.352\ \text{dm}^3$.

Subtract the answer to question 2 from the answer to question 1.

$$200\ 000\ \text{cm}^3 - 123\ 648\ \text{cm}^3 = 76\ 352\ \text{cm}^3$$

or

$$200\ \text{dm}^3 - 123.648\ \text{dm}^3 = 76.352\ \text{dm}^3$$

Keystrokes

1. a.
$$\begin{array}{r} 68\text{ m} \\ \times\ 43\text{ m} \\ \hline 2924\text{ m}^2 \end{array} \qquad \begin{array}{r} 86\text{ m} \\ \times\ 34\text{ m} \\ \hline 2924\text{ m}^2 \end{array}$$

b.
$$\begin{array}{r} 36\text{ m} \\ \times\ 42\text{ m} \\ \hline 1512\text{ m}^2 \end{array} \qquad \begin{array}{r} 63\text{ m} \\ \times\ 24\text{ m} \\ \hline 1512\text{ m}^2 \end{array}$$

c.
$$\begin{array}{r} 21\text{ m} \\ \times\ 24\text{ m} \\ \hline 504\text{ m}^2 \end{array} \qquad \begin{array}{r} 12\text{ m} \\ \times\ 42\text{ m} \\ \hline 504\text{ m}^2 \end{array}$$

2. When the digits in both factors are reversed, the product stays the same.

3. a.
$$\begin{array}{r} 37\text{ m} \\ \times\ 42\text{ m} \\ \hline 1554\text{ m}^2 \end{array} \qquad \begin{array}{r} 73\text{ m} \\ \times\ 24\text{ m} \\ \hline 1752\text{ m}^2 \end{array}$$

b.
$$\begin{array}{r} 48\text{ m} \\ \times\ 21\text{ m} \\ \hline 1008\text{ m}^2 \end{array} \qquad \begin{array}{r} 84\text{ m} \\ \times\ 12\text{ m} \\ \hline 1008\text{ m}^2 \end{array}$$

c.
$$\begin{array}{r} 25\text{ m} \\ \times\ 41\text{ m} \\ \hline 1025\text{ m}^2 \end{array} \qquad \begin{array}{r} 52\text{ m} \\ \times\ 14\text{ m} \\ \hline 728\text{ m}^2 \end{array}$$

4. The product of the tens digits in the factors must equal the product of the ones digits in the factors.

5. Answers will vary. Sample answers are given.

$93 \times 13 = 39 \times 31 = 1209$
$36 \times 84 = 63 \times 48 = 3204$
$82 \times 14 = 28 \times 41 = 1148$

6. a. $31\text{ m}\times 39\text{ m}=1209\text{ m}^2$ $45\text{ m}\times 45\text{ m}=2025\text{ m}^2$

$32\text{ m}\times 38\text{ m}=1216\text{ m}^2$ $67\text{ m}\times 63\text{ m}=4221\text{ m}^2$

b. For each pair of numbers being multiplied, both of their tens digits are the same and the sum of their ones digits is 10.

c. The number formed by the tens and ones digits in each answer is the product of the ones digits.

d. The number formed by the thousands and hundreds digits in each answer is the product of the tens digit multiplied by the next consecutive number (one more than the tens digit).

7. $16\text{ m}\times 14\text{ m}=224\text{ m}^2$

$85\text{ m}\times 85\text{ m}=7225\text{ m}^2$

$48\text{ m}\times 42\text{ m}=2016\text{ m}^2$

$95\text{ m}\times 95\text{ m}=9025\text{ m}^2$

8. Answers will vary. Sample answers are given.

$25\text{ m}\times 25\text{ m}=625\text{ m}^2$

$77\text{ m}\times 73\text{ m}=5621\text{ m}^2$

$105\text{ m}\times 105\text{ m}=11\,025\text{ m}^2$

Review

1. Textbook, page 53, On Your Own, questions 1 to 5

1. Answers will vary. Sample answers are given.

A quarter is about 1.5 mm thick. A stack of quarters 1 m high would be worth more than \$50, but less than \$200.

- $\$1=4$ quarters, and $4\times 1.5\text{ mm}=6\text{ mm}$
- $1\text{ m}=1000\text{ mm}$
- $1000\text{ mm}\div 6$ is about 167, so 1 m is worth about \$167.

2. Answers will vary. Sample answers are given.

   You would write the circumference of a quarter in millimetres or centimetres. It is about $75\text{ mm}=7.5\text{ cm}$. Both numbers are easy to understand.

3. Answers will vary. Sample answers are given.

   Multiply the time it takes to walk 10 m by 100.

   $1\text{ km}=1000\text{ m}$ and $1000\text{ m}\div 10\text{ m}=100$ times

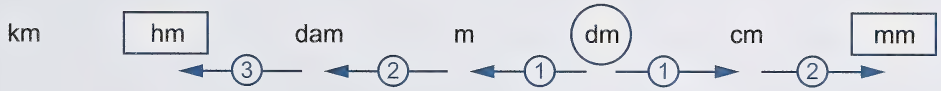
4. Answers will vary. Sample answers are given.

   Two objects that are about 1 dm long are a small stapler and the palm of your hand. A calculator is measured to be 115 mm long.

   $115\text{ mm}=11.5\text{ cm}=1.15\text{ dm}=0.115\text{ m}$

5. Answers will vary. Sample answers are given.

   There is a pattern when you convert from one linear measurement to another in the SI system. Ten of a smaller unit make one of the next larger unit, so move the decimal point one place in the same direction for each move along the following linear measurement scale.



To change from decimetres to hectometres, move the decimal three places left.

To change from decimetres to millimetres, move the decimal two places right.

2. Textbook, page 53, Practise Your Skills, questions 1 to 12

1. cm to mm is 1 right:
   $8\text{ cm}=80\text{ mm}$

2. mm to cm is 1 left:
   $40\text{ mm}=4\text{ cm}$

3. m to cm is 2 right:
   $3\text{ m}=300\text{ cm}$

4. cm to m is 2 left:
   $750\text{ mm}=7.5\text{ m}$

5. cm to mm is 1 right:
2.4 cm = 24 mm

6. m to mm is 3 right:
0.5 m = 500 mm

7. dm to cm is 1 right:
7 dm = 70 cm

8. mm to dm is 2 left:
500 mm = 5 dm

9. km to m is 3 right:
4 km = 4000 m

10. m to km is 3 left:
247 m = 0.247 km

11. km to m is 3 right:
0.4 km = 400 m

12. km to m is 3 right:
5.6 km = 5600 km

3.

Number of Coins	Mass (g)	Mass (kg)	Mass (t)
4	100	0.1	0.0001
40	1000	1	0.001
400	10 000	10	0.01
4000	100 000	100	0.1
40 000	1 000 000	1000	1

4. **a.** Four cans of tuna have a mass of 1 kg.

$1\text{ kg} = 1000\text{ g};\ 1000\text{ g} \div 250\text{ g} = 4$

b. Four thousand cans have a mass of 1 t.

$1\text{ t} = 1000\text{ kg};\ 1000 \times 4 = 4000$

c. The mass of 50 cans is $50 \times 250\text{ g} = 12\,500\text{ g}$.

$12\,500\text{ g} \div 1000 = 12.5\text{ kg}$
$12.5\text{ kg} \div 1000 = 0.0125\text{ t}$

5. **a.** You need $250\ \text{mL} = 0.25\ \text{L}$ of vegetable oil to make pancakes for 8 people.

$8 \div 4 = 2$

$2 \times 125\ \text{mL} = 250\ \text{mL}$

$250\ \text{mL} \div 1000 = 0.25\ \text{L}$

b. You need $750\ \text{mL} = 0.75\ \text{L}$ of vegetable oil to make pancakes for 8 people.

$24 \div 4 = 6$

$6 \times 125\ \text{mL} = 750\ \text{mL}$

$750\ \text{mL} \div 1000 = 0.75\ \text{L}$

c. You need $15\,625\ \text{mL} = 15.625\ \text{L}$ of vegetable oil to make pancakes for 500 people.

$500 \div 4 = 125$

$125 \times 125\ \text{mL} = 15\,625\ \text{mL}$

$15\,625\ \text{mL} \div 1000 = 15.625\ \text{L}$

6. **a.** Multiply the recipe 8000 times.

$1\ \text{kL} = 1000\ \text{L}$

$1000\ \text{L} \div 0.125\ \text{L} = 8000\ \text{recipes}$

b. You would make 32 000 servings.

$8000\ \text{recipes} \times 4\ \text{servings/recipe} = 32\,000$ servings

7. **a.** You would have to open three cans.

$2 \times 355\ \text{mL} = 710\ \text{mL}$ and $3 \times 355\ \text{mL} = 1065\ \text{mL}$

b. The capacity of 12 cans is $12 \times 355\ \text{mL} = 4260\ \text{mL}$.

$4260\ \text{mL} \div 1000 = 4.26\ \text{L}$

c. 2816 full cans could be filled with 1 kL of orange drink.

$$1 \text{ kL} = 1000 \text{ L} = 1\,000\,000 \text{ mL}$$
$$1\,000\,000 \text{ mL} \div 355 \text{ mL} = 2816.9 \text{ cans}$$

8. Textbook, page 277, Practise Your Skills, questions 1 and 2

1. **a.** $\text{perimeter} = 6 \times 1.5 \text{ cm} = 9 \text{ cm}$

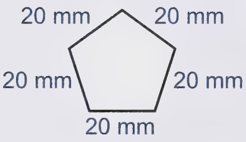
b. $\text{perimeter} = 8 \times 1 \text{ cm} = 8 \text{ cm}$

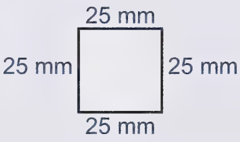
c.
$$\begin{aligned}\text{perimeter} &= (2 \times 1.5 \text{ cm}) + (2 \times 0.5 \text{ cm}) + 1 \text{ cm}\\ &= 3 \text{ cm} + 1 \text{ cm} + 1 \text{ cm}\\ &= 5 \text{ cm}\end{aligned}$$

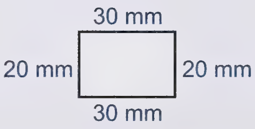
d.
$$\begin{aligned}\text{perimeter} &= (2 \times 4.0 \text{ cm}) + (2 \times 1.5 \text{ cm})\\ &= 8 \text{ cm} + 3 \text{ cm}\\ &= 11 \text{ cm}\end{aligned}$$

2. Answers will vary. Sample answers are given.

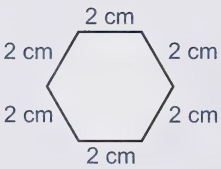
a. 100 mm

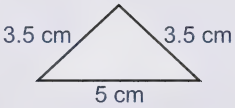

20 mm
20 mm
20 mm
20 mm
20 mm

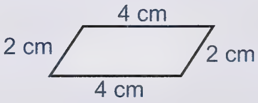

25 mm
25 mm
25 mm
25 mm


30 mm
20 mm
20 mm
30 mm

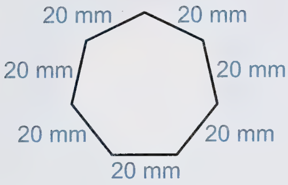
b. 12 cm

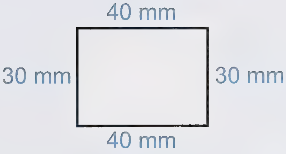

2 cm
2 cm
2 cm
2 cm
2 cm
2 cm

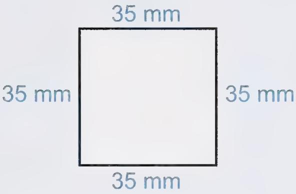

3.5 cm
3.5 cm
5 cm


4 cm
2 cm
2 cm
4 cm

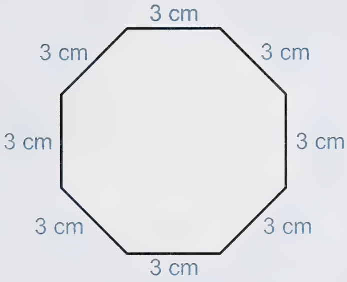
c. 140 cm

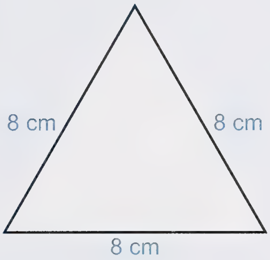

20 mm
20 mm
20 mm
20 mm
20 mm
20 mm
20 mm

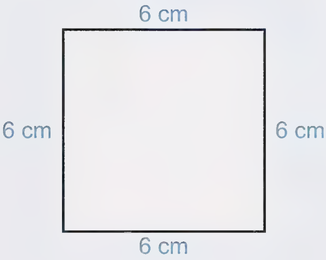

40 mm
30 mm
30 mm
40 mm


35 mm
35 mm
35 mm
35 mm

d. 24 cm


3 cm
3 cm
3 cm
3 cm
3 cm
3 cm
3 cm
3 cm




6 cm
6 cm
6 cm
6 cm

9. Textbook, page 290, Skill Bank from This Unit, questions 1 and 2

1. a. perimeter

$$\begin{aligned} &= (3 \times 4\ \text{m}) + (2 \times 6\ \text{m}) \\ &= 12\ \text{m} + 12\ \text{m} \\ &= 24\ \text{cm} \end{aligned}$$

b. perimeter

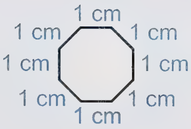
$$\begin{aligned} &= (2 \times 12\ \text{mm}) + (2 \times 28\ \text{mm}) \\ &= 24\ \text{mm} + 56\ \text{cm} \\ &= 80\ \text{mm} \end{aligned}$$

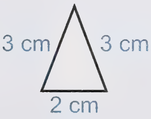
c. perimeter

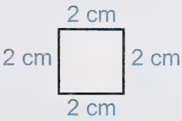
$$\begin{aligned} &= 6 \times 7\ \text{m} \\ &= 42\ \text{m} \end{aligned}$$

2. Answers will vary. Sample answers are given.

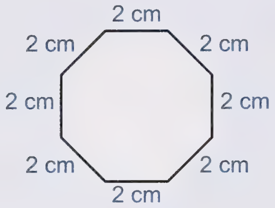
a. 8 cm

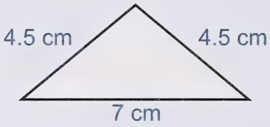

1 cm
1 cm
1 cm
1 cm
1 cm
1 cm
1 cm
1 cm

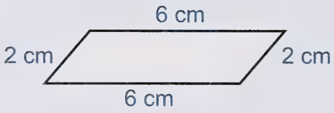



2 cm
2 cm
2 cm
2 cm

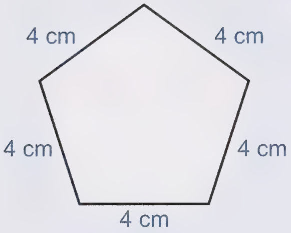
b. 16 cm

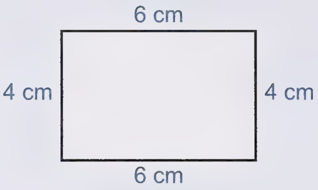

2 cm
2 cm
2 cm
2 cm
2 cm
2 cm
2 cm
2 cm

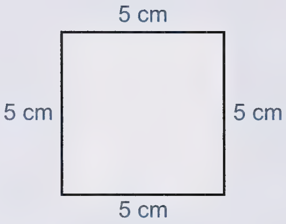

4.5 cm
4.5 cm
7 cm


6 cm
2 cm
2 cm
6 cm

c. 20 cm


4 cm
4 cm
4 cm
4 cm
4 cm


6 cm
4 cm
4 cm
6 cm


5 cm
5 cm
5 cm
5 cm

10. Textbook, page 280, Practise Your Skills, questions 1 to 8

1. $\text{area} = 30\ \text{mm} \times 40\ \text{mm}$

$= 1200\ \text{mm}^2$

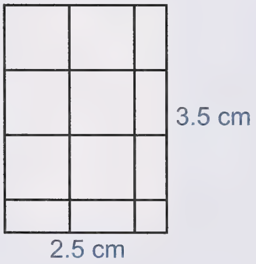
2. $\text{area} = 2\ \text{cm} \times 6\ \text{cm}$

$= 12\ \text{cm}^2$

3. $\text{area} = 5\ \text{cm} \times 1.5\ \text{cm}$

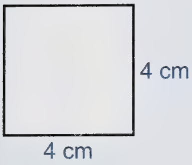
$= 7.5\ \text{cm}^2$

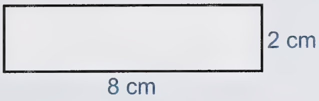
4.

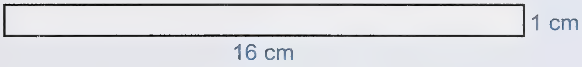


$$\begin{aligned} \text{area:}\quad & 6\ \text{whole squares} = 6\ \text{cm}^2 \\ & +5\ \text{half-squares} = 2.5\ \text{cm}^2 \\ & +1\ \text{quarter-square} = \underline{0.25\ \text{cm}^2} \\ & = 8.75\ \text{cm}^2 \end{aligned}$$

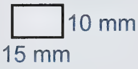
5. 16 cm^2

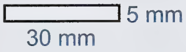


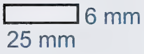




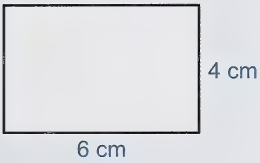
6. 150 mm^2

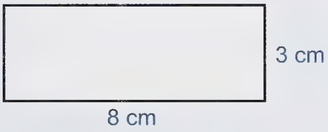


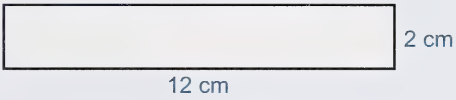




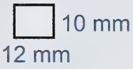
7. 24 cm^2

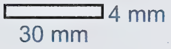


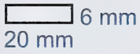




8. 120 mm^2







11. Textbook, page 290, Skill Bank from This Unit, questions 3 and 4

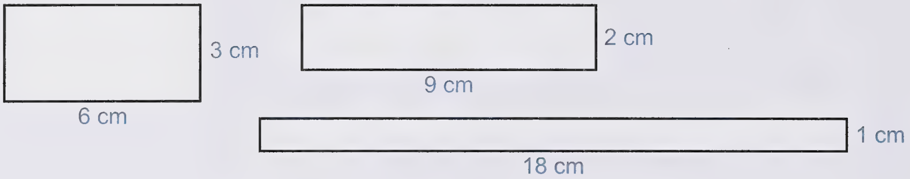
3. a. $\text{area} = 40 \text{ mm} \times 60 \text{ mm}$
$= 2400 \text{ cm}^2$

b. $\text{area} = 8 \text{ mm} \times 20 \text{ mm}$
$= 160 \text{ mm}^2$

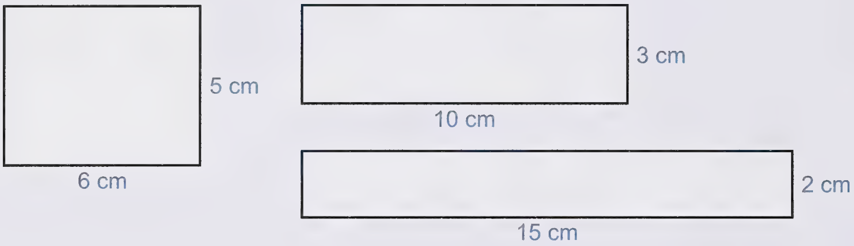
c. $\text{area} = 2.0 \text{ m} \times 1.5 \text{ m}$
$= 3 \text{ m}^2$

4. Answers will vary. Sample answers are given.

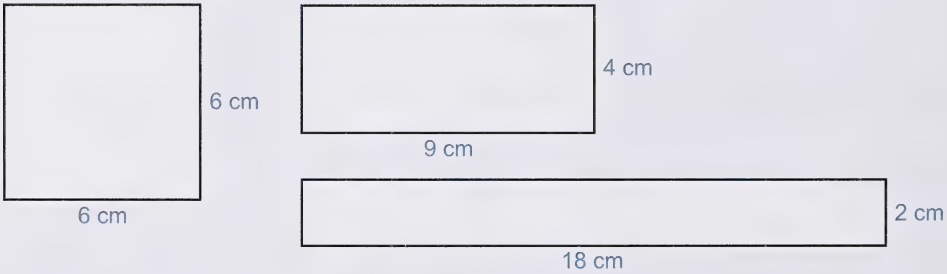
a. 18 cm^2


3 cm
6 cm
2 cm
9 cm
1 cm
18 cm

b. 30 cm^2

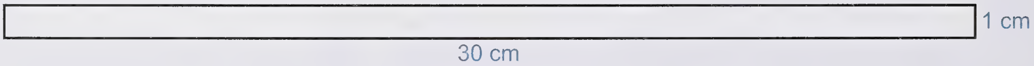

5 cm
6 cm
3 cm
10 cm
2 cm
15 cm

c. 36 cm^2

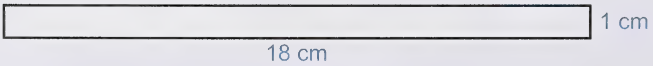

6 cm
6 cm
4 cm
9 cm
2 cm
18 cm

12. Textbook, page 283, Practise Your Skills, questions 1 to 12

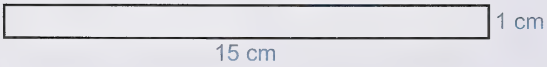
1.

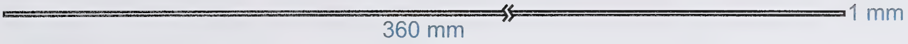


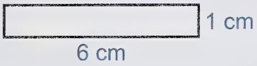
2.

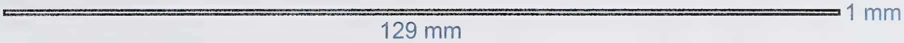


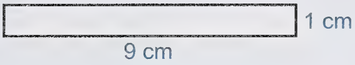
3.

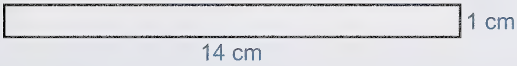


4. 

5. 

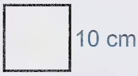
6. 

7. 

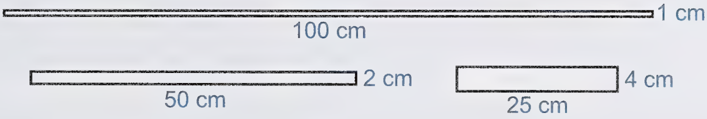
8. 

9. Square: perimeter = 40 cm

area = 100 cm^2

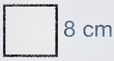


Rectangles: area = 100 cm^2

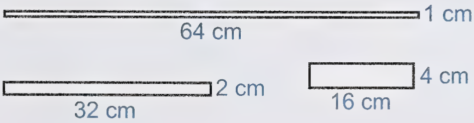

1 cm
100 cm
2 cm
50 cm
4 cm
25 cm

10. Square: perimeter = 32 cm

area = 64 cm^2

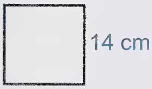


Rectangles: area = 64 cm^2

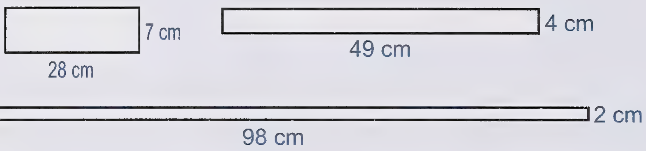

1 cm
64 cm
2 cm
32 cm
4 cm
16 cm

11. Square: perimeter = 56 cm

area = 196 cm^2

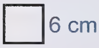


Rectangles: area $= 196 \text{ cm}^2$

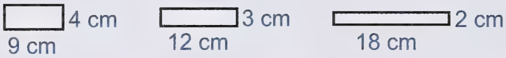

7 cm
28 cm
4 cm
49 cm
2 cm
98 cm

12. Square: perimeter $= 24$ cm

area $= 36 \text{ cm}^2$

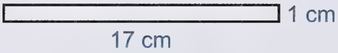


Rectangles: area $= 36 \text{ cm}^2$

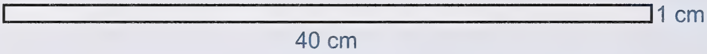

4 cm
9 cm
3 cm
12 cm
2 cm
18 cm

13. Textbook, page 290, Skill Bank from this Unit, questions 5 to 7

5. perimeter $= 36$ cm, least area $= 17$ cm



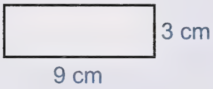
6. area $= 40 \text{ cm}^2$, greatest perimeter $= 82$ cm



7. Answers will vary. Sample answers are given.

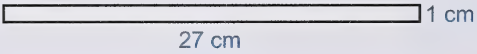
Sample Solution A

a. area $= 27 \text{ cm}^2$



b. perimeter $= 24$ cm

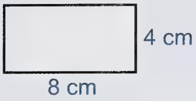
Sample Solution B



perimeter $= 56$ cm

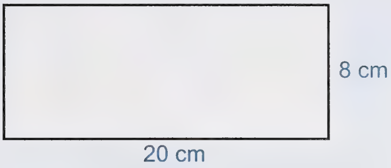
Sample Solution A

c.



d. area $= 32\ \text{cm}^2$

Sample Solution B



area $= 160\ \text{cm}^2$

14. Textbook, page 237, On Your Own, questions 1 to 3

1. volume of box $= 6\ \text{cm} \times 8\ \text{cm} \times 4\ \text{cm} = 192\ \text{cm}^3$

2. Answers will vary. Sample answers are given.

The dimensions could be $2\ \text{cm} \times 2\ \text{cm} \times 48\ \text{cm}$, $2\ \text{cm} \times 4\ \text{cm} \times 24\ \text{cm}$, $2\ \text{cm} \times 8\ \text{cm} \times 12\ \text{cm}$, $2\ \text{cm} \times 16\ \text{cm} \times 6\ \text{cm}$, $2\ \text{cm} \times 32\ \text{cm} \times 3\ \text{cm}$, $4\ \text{cm} \times 3\ \text{cm} \times 16\ \text{cm}$, and $8\ \text{cm} \times 3\ \text{cm} \times 8\ \text{cm}$. Other answers are possible.

3. Answers will vary. Sample answers are given.

The volume of the box will be $2 \times 192\ \text{cm}^3 = 384\ \text{cm}^3$.

The dimensions could be $8\ \text{cm} \times 8\ \text{cm} \times 6\ \text{cm}$, $4\ \text{cm} \times 16\ \text{cm} \times 6\ \text{cm}$, $4\ \text{cm} \times 8\ \text{cm} \times 12\ \text{cm}$, $2\ \text{cm} \times 2\ \text{cm} \times 96\ \text{cm}$, $2\ \text{cm} \times 4\ \text{cm} \times 48\ \text{cm}$, $2\ \text{cm} \times 8\ \text{cm} \times 24\ \text{cm}$, $2\ \text{cm} \times 32\ \text{cm} \times 6\ \text{cm}$, $2\ \text{cm} \times 64\ \text{cm} \times 3\ \text{cm}$, $4\ \text{cm} \times 3\ \text{cm} \times 32\ \text{cm}$, and $8\ \text{cm} \times 3\ \text{cm} \times 16\ \text{cm}$. Other answers are possible.

15. Textbook, page 241, On Your Own, questions 1 to 5

1. dimensions for 8 cubes

- 1 by 1 by 8 (greatest surface area)
- 1 by 2 by 4
- 2 by 2 by 2 (least surface area)

2. dimensions for 27 cubes

- 1 by 1 by 27 (greatest surface area)
- 1 by 3 by 9
- 3 by 3 by 3 (least surface area)

3. dimensions for 36 cubes

- 1 by 1 by 36 (greatest surface area)
- 1 by 2 by 18
- 1 by 3 by 12

- 1 by 4 by 9
- 1 by 6 by 6
- 2 by 2 by 9
- 2 by 3 by 6
- 3 by 3 by 4 (least surface area)

4. dimensions for 48 cubes

- 1 by 1 by 48 (greatest surface area)
- 1 by 2 by 24
- 1 by 3 by 16
- 1 by 4 by 12
- 1 by 6 by 8
- 2 by 2 by 12
- 2 by 3 by 8
- 2 by 4 by 6
- 3 by 4 by 4 (least surface area)

5. dimensions for 60 cubes

- 1 by 1 by 60 (greatest surface area)
- 1 by 2 by 30
- 1 by 3 by 20
- 1 by 4 by 15
- 1 by 5 by 12
- 1 by 6 by 10
- 2 by 2 by 15
- 2 by 3 by 10
- 2 by 5 by 6
- 3 by 4 by 5 (least surface area)

16. Textbook, page 241, Practise Your Skills

Length	Width	Height	Volume	Surface Area
4 cm	2 cm	5 cm	$4\text{ cm}\times 2\text{ cm}\times 5\text{ cm}$ $=40\text{ cm}^3$	$2\text{ faces }(4\text{ cm}\times 2\text{ cm})=16\text{ cm}^2$ $2\text{ faces }(4\text{ cm}\times 5\text{ cm})=40\text{ cm}^2$ $2\text{ faces }(2\text{ cm}\times 5\text{ cm})=20\text{ cm}^2$ $16\text{ cm}^2+40\text{ cm}^2+20\text{ cm}^2=76\text{ cm}^2$
4 cm	2 cm	10 cm	$4\text{ cm}\times 2\text{ cm}\times 10\text{ cm}$ $=80\text{ cm}^3$	$2\text{ faces }(4\text{ cm}\times 2\text{ cm})=16\text{ cm}^2$ $2\text{ faces }(4\text{ cm}\times 10\text{ cm})=80\text{ cm}^2$ $2\text{ faces }(2\text{ cm}\times 10\text{ cm})=40\text{ cm}^2$ $16\text{ cm}^2+80\text{ cm}^2+40\text{ cm}^2=136\text{ cm}^2$
4 cm	4 cm	5 cm	$4\text{ cm}\times 4\text{ cm}\times 5\text{ cm}$ $=80\text{ cm}^3$	$2\text{ faces }(4\text{ cm}\times 4\text{ cm})=32\text{ cm}^2$ $4\text{ faces }(4\text{ cm}\times 5\text{ cm})=80\text{ cm}^2$ $32\text{ cm}^2+80\text{ cm}^2=112\text{ cm}^2$
8 cm	2 cm	5 cm	$8\text{ cm}\times 2\text{ cm}\times 5\text{ cm}$ $=80\text{ cm}^3$	$2\text{ faces }(8\text{ cm}\times 2\text{ cm})=32\text{ cm}^2$ $2\text{ faces }(8\text{ cm}\times 5\text{ cm})=80\text{ cm}^2$ $2\text{ faces }(2\text{ cm}\times 5\text{ cm})=20\text{ cm}^2$ $32\text{ cm}^2+80\text{ cm}^2+20\text{ cm}^2=132\text{ cm}^2$

17. Textbook, page 246, Skill Bank from This Unit, questions 4 and 5

4. **a.** surface area $=108$ square units

$2\text{ faces }(6\text{ units}\times 3\text{ units})=36\text{ square units}$

$2\text{ faces }(6\text{ units}\times 4\text{ units})=48\text{ square units}$

$2\text{ faces }(3\text{ units}\times 4\text{ units})=24\text{ square units}$

$36\text{ square units}+48\text{ square units}+24\text{ square units}=108\text{ square units}$

b. surface area $= 144$ square units

2 faces $(4 \text{ units} \times 4 \text{ units}) = 32$ square units

4 faces $(4 \text{ units} \times 7 \text{ units}) = 112$ square units

32 square units $+ 112$ square units $= 144$ square units

c. surface area $= 202$ square units

2 faces $(5 \text{ units} \times 4 \text{ units}) = 40$ square units

2 faces $(5 \text{ units} \times 9 \text{ units}) = 90$ square units

2 faces $(4 \text{ units} \times 9 \text{ units}) = 72$ square units

40 square units $+ 90$ square units $+ 72$ square units $= 202$ square units

d. surface area $= 96$ square units

6 faces $(4 \text{ units} \times 4 \text{ units}) = 6 \times 16$ square units $= 96$ square units

5. a. volume $= 6 \text{ units} \times 3 \text{ units} \times 4 \text{ units} = 72$ cubic units
b. volume $= 4 \text{ units} \times 4 \text{ units} \times 7 \text{ units} = 112$ cubic units
c. volume $= 5 \text{ units} \times 4 \text{ units} \times 9 \text{ units} = 180$ cubic units
d. volume $= 4 \text{ units} \times 4 \text{ units} \times 4 \text{ units} = 64$ cubic units

18. a. The volume of the rubber ball was 33 cm^3.

$142 \text{ mL} - 110 \text{ mL} = 32 \text{ mL} = 32 \text{ cm}^3$

The volume of the marble was 4 cm^3.

$146 \text{ mL} - 142 \text{ mL} = 4 \text{ mL} = 4 \text{ cm}^3$

b. The volume of the rubber ball was 8 times greater than the volume of the marble.

19. The bananas had volumes of $214\ \text{cm}^3$ and $142\ \text{cm}^3$.

- One banana is $856\ \text{mL} - 642\ \text{mL} = 214\ \text{mL} = 214\ \text{cm}^3$.
- The sum of two bananas is $856\ \text{mL} - 500\ \text{mL} = 356\ \text{mL} = 356\ \text{cm}^3$. So, the other banana is $356\ \text{mL} - 214\ \text{mL} = 142\ \text{mL} = 142\ \text{cm}^3$.

20. a. Textbook, page 288, Problem Bank, question 1 or 2

1. A rectangle that is not square could have "whole centimetre" sides of 1 cm by 9 cm, 2 cm by 8 cm, 3 cm by 7 cm, or 4 cm by 6 cm.

A square would have sides of 5 cm.

A regular pentagon would have sides of 4 cm.

2. The length of the rectangle is 30 mm and the width is 15 mm.

$$\text{length} + \text{width} = 90\ \text{mm} \div 2 = 45\ \text{mm}$$
$$15\ \text{mm} + 30\ \text{mm} = 45\ \text{mm}$$

b. Textbook, page 288, Problem Bank, question 3

3. a.
$$\begin{aligned}\text{perimeter} &= 2(4\ \text{cm} + 2.5\ \text{cm})\\ &= 2 \times 6.5\ \text{cm}\\ &= 13\ \text{cm}\end{aligned}$$

b.
$$\begin{aligned}\text{perimeter} &= (3\ \text{cm} \times 2.3\ \text{cm}) + 4\ \text{cm}\\ &= 6.9\ \text{cm} + 4\ \text{cm}\\ &= 10.9\ \text{cm}\end{aligned}$$

c.
$$\begin{aligned}\text{perimeter} &= 2(3\ \text{cm} + 1.6\ \text{cm})\\ &= 2 \times 4.6\ \text{cm}\\ &= 9.2\ \text{cm}\end{aligned}$$

d.
$$\begin{aligned}\text{perimeter} &= 4.2\ \text{cm} + 3.3\ \text{cm} + 2.5\ \text{cm}\\ &= 10\ \text{cm}\end{aligned}$$

c. **Textbook, page 288, Problem Bank, question 4 or 5**

4. perimeter $= 65\ \text{cm} + 100\ \text{cm} + 150\ \text{cm} + 73\ \text{cm} + 76\ \text{cm}$

$= 464\ \text{cm}$

or

$= 0.65\ \text{cm} + 1\ \text{m} + 1.5\ \text{m} + 0.73\ \text{m} + 0.76\ \text{m}$

$= 4.64\ \text{m}$

5. Each side of the square $= 300\ \text{cm} \div 4 = 75\ \text{cm} = 0.75\ \text{m}$.

d. **Textbook, page 289, Problem Bank, question 7**

7.
- Light switch: perimeter $= 2(11\ \text{cm} + 7\ \text{cm})$ $= 2 \times 18\ \text{cm}$ $= 36\ \text{cm}$; area $= 11\ \text{cm} \times 7\ \text{cm}$ $= 77\ \text{cm}^2$
- \$5 bill: perimeter $= 2(15\ \text{cm} + 7\ \text{cm})$ $= 2 \times 22\ \text{cm}$ $= 44\ \text{cm}$; area $= 15\ \text{cm} \times 7\ \text{cm}$ $= 105\ \text{cm}^2$
- business card: perimeter $= 2(9\ \text{cm} + 5\ \text{cm})$ $= 2 \times 14\ \text{cm}$ $= 28\ \text{cm}$; area $= 9\ \text{cm} \times 5\ \text{cm}$ $= 45\ \text{cm}^2$
- chalkboard: perimeter $= 2(90\ \text{cm} + 80\ \text{cm})$ $= 2 \times 170\ \text{cm}$ $= 340\ \text{cm}$; area $= 90\ \text{cm} \times 80\ \text{cm}$ $= 7200\ \text{cm}^2$

e. **Textbook, page 289, Problem Bank, question 8 or 9**

8. If you double the length of each side of a square, the area is quadrupled. For example, a 3 cm by 3 cm square with an area of $9\ \text{cm}^2$ becomes a 6 cm by 6 cm square with area of $36\ \text{cm}^2$ and $4 \times 9\ \text{cm}^2 = 36\ \text{cm}^2$.

9. The length and width of the park, in whole kilometres, may be 1 km by 12 km, 2 km by 6 km, or 3 km by 4 km.

f. Textbook, page 289, Problem Bank, question 10

10.
- Soccer: length $= 4050\ \text{m}^2 \div 45\ \text{m} = 90\ \text{m}$
- Hockey: area $= 60\ \text{m} \times 30\ \text{m} = 1800\ \text{m}^2$
- Tennis: length $= 600\ \text{m}^2 \div 20\ \text{m} = 30\ \text{m}$
- Basketball: length $= 364\ \text{m}^2 \div 14\ \text{m} = 26\ \text{m}$
- Football: width $= 7250\ \text{m}^2 \div 145\ \text{m} = 50\ \text{m}$

g. Textbook, page 289, Problem Bank, question 11 or 12

11. The length and width of the garden, in whole metres, may be 1 m by 120 m, 2 m by 60 m, 3 m by 40 m, 4 m by 30 m, 5 m by 24 m, 6 m by 20 m, 8 m by 15 m, or 10 m by 12 m. The dimensions with the shortest perimeter are 10 m by 12 m. It is the rectangle that looks most like a square.

12. The length of the rectangle is 9 cm and the width is 6 cm.

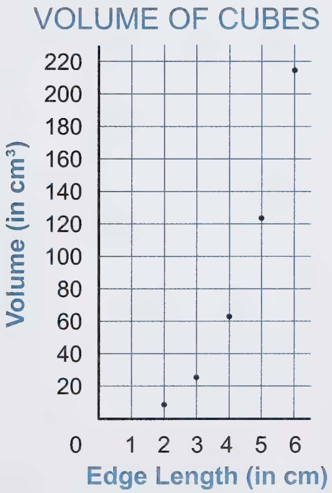
- length $\times$ width $= 54\ \text{cm}^2$
- $54\ \text{cm}^2 = 1\ \text{cm} \times 54,\ 2\ \text{cm} \times 27\ \text{cm},\ 3\ \text{cm} \times 18\ \text{cm}$, or $6\ \text{cm} \times 9\ \text{cm}$
- $9\ \text{cm} - 6\ \text{cm} = 3\ \text{cm}$

21. Textbook, pages 244 to 245, Problem Bank, questions 3 and 4

3. a.

Edge Length (in cm)	Number of Centimetre Cubes
2	8
3	27
4	64
5	125
6	216

b.

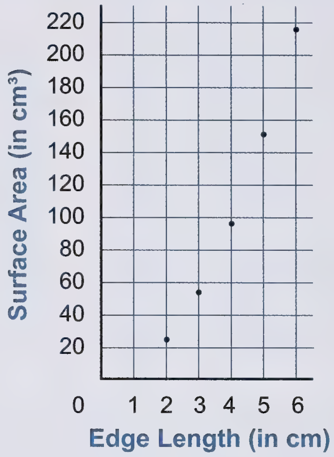


The points of the graph follow a curved path that bends upward.

4. a.

Edge Length (in cm)	Surface Area (in cm^2)
2	24
3	54
4	96
5	150
6	216

b. SURFACE AREA OF CUBES



The points of the graph follow a curved path that bends upward.

Just the Facts

Multiplication and Division Facts

0
3
6
5
40
6
45
8
21
7
4
4
24
3
7
9
12
1
36
3
42
8
5
0
0

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